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A. SHAROV

LIFE TRIUMPHS

A STORY OF HEROES OF SCIENCE

FOREIGN LANGUAGES PUBLISHING HOUSE
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TRANSLATED BY VIOLET DUTT

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THE BEGINNING OF THE JOURNEY

DANILO SAMOILOVICH

In the summer of 1945 workmen were pulling down the brickwork round a monument on the Grabenstrasse in Vienna. It was a monument to mark the end of plague in the city and it had been bricked up during the war to protect the old marble against bombs. Gradually the monument was laid bare, revealing a shapeless mass of grey clouds with kneeling figures in their midst.

The clouds cut from marble looked more like lava; it was as though a white-hot torrent were rolling down, one wave striking against another in an instantaneous blow; the arms of a helpless man were raised in entreaty before the raging elements.

It is a monument not glorifying the life and courage of the living but the power of death. It is hard to imagine why it should ever have been conceived and erected. For the history of the struggle against plague is one of the clearest testimonies to the power of man; a history which shows that man is even stronger than the most terrible forces of nature.

* * *

Under the Emperor Justinian, half the population of the East Roman Empire died of plague. Between 1347 and 1350 the epidemic wiped out 60 million people. Whole towns and countries were converted into graveyards. "I am writing amidst death, in the anticipation of death," wrote John Clyn, a Franciscan monk who witnessed these events. Since then the disease has appeared again and again. It is impossible to state exactly the total number of victims mankind has sacrificed to plague; it is measured in hundreds of millions.

Against such an enemy a small group of Russian scientists set forth. They did not consider themselves heroes, they simply worked to protect the world against a terrible danger. From the middle of the eighteenth century to the present day Russian scientists have been winning back from plague one position after another.

* * *

Isolated cases of plague were observed among the Russian troops fighting against the Turkish army in Moldavia in 1770. Doctors tried to cut off the epidemic by means of quarantines, but it rapidly spread to the territories of the Ukraine and Poland and reached Moscow a few months later, in the autumn of the same year.

While still in the Balkans, preparing to leave the Danube army and bidding farewell to the officers and men of the Orenburg regiment, where he had worked as army physician during the whole of the second half of the Russo-Turkish war, Danilo Samoilovich was aware that there was a plague epidemic in Moscow. Eyewitnesses reported that the dead were heaped up in the streets, there were not enough doctors and the few to be found were fleeing from the town because "who, after all, wants to die."

After hearing the reports he looked contemptuously into the staring eyes of the talebearers (Danilo Samoilovich said of cowards: "I don't like them, I have no pity for them, and I don't understand sympathy for them").

"Soldiers don't like dying either," he said, interrupting one eyewitness. "Yet they go into battle and die."

"They die with glory, but these. . . ."

"Whether there is glory or not depends on the man himself."

During his last campaign Danilo Samoilovich had been tortured by severe fever. After the illness he emerged leaner than usual. His grey eyes were sunk in their sockets, but they shone as boldly and defiantly as ever. He found it hard to rise from the bed, his head swam when he went out into the air, yet as soon as he obtained leave from Rumyantsev's army he decided to go straight to Moscow without breaking his journey. He had encountered plague during the war and he knew only too well the harm the disease could bring to his country. He was a soldier of the Suvorov school, which meant he was guided by one rule: find the hardest work in life, the most dangerous zone in battle, for only there is the fate of the battle decided.

Incidentally, he was more a scientist than a soldier. The plague which had destroyed thousands of people and the mere mention 'of which put people to flight had engaged his attention ever since his first encounter with it at Khotin, Brailov and Bucharest. Danilo Samoilovich had his own ideas about the causes of plague and they could only be verified by making a long study of the course of the epidemic and observing the condition of the patients.

He was only twenty-five, but he had formed definite views about science, which he loved more than life. This young doctor believed only what he could see with his own eyes. Then and later he adhered to the firm rule: "take account only of things that exist (the facts) and which are confirmed by actual experiments and avoid all speculative, imaginary, fantastic descriptions." He travelled to Moscow for three reasons: because he loved the town with all his heart and considered it his duty to be there when it was in danger, and also because he knew that as a scientist he had no right to miss a single opportunity of meeting plague.

He travelled rapidly. When the compassionate officials at the posting stations saw the pale face of the traveller they advised him to rest and recuperate.

"That may be all right for some people," he replied. "My cure is the open road, the sun, the stars, the wind in my face."

He had planned to rest a few days in Moscow, but as he walked through the deserted streets, past houses with shutters closed or nailed up, after seeing the first dead on the porch of St. Basil's Cathedral on the Red Square, he decided that this was no time to be resting.

The following morning he reported to the authorities and was appointed to the hospital in Simon monastery. The clerk who handed Danilo Samoilovich his papers looked pityingly at the young doctor and could not restrain himself from showing sympathy:

"How could they send you there, to the most dangerous place. There is only one road out of it . . ." said the clerk, his yellow, tobacco-stained finger pointing upwards.

Danilo Samoilovich stood before him in his army dress tunic. His high receding forehead disappeared under a finely-curled powdered wig. His face was lean and yellow, his cheek-bones were prominent under the fine skin. There was a polite smile on the clearly defined lips and his nostrils were dilated as always when he was agitated and gave his face a belligerent expression which the smile belied. He replied softly, carefully choosing his words:

"D'you know who was the first person to spread plague? The coward! The man who fell victim to fear."

Samoilovich presented himself for duty wearing the same dress uniform. He changed into his hospital clothing and slowly passed through the dim, low-ceilinged cells, closely packed with sick and dying. To him one thing was clear: the horror of plague held sway over Russia and the world. So long as this horror continued to exist there was no hope of halting the epidemic.

Some doctors never showed themselves in the wards and those that did pay rare visits stood no nearer than three yards from the patients and talked to them through vinegar-soaked handkerchiefs held up to their faces. But there were some real doctors, for example, Pyotr Ivanovich Pogoretsky. He had been dismissed from work at the Hospital School where the hidebound "German Party" were in control and he remained of his own free will in Moscow to help fight the epidemic by working in the Simon monastery. It was there he made friends with Danilo Samoilovich at once and for all time. Then there was Kasyan Osipovich Yagelsky, a young man very ill with consumption. He was bright-eyed and had unhealthy spots burning in his cheeks and was engrossed in scientific plans which many people regarded as impossible of realization. When not occupied with his patients, he spent all his time on laboratory experiments.

Thus a small but very close circle of doctors was formed round Danilo Samoilovich.

Samoilovich and his friends would stand for a long time by each of the patients, asking detailed questions and carefully writing down the replies; always they carefully examined and sounded the patients and saw to it that the nurses adhered strictly to the rules.

After the first few weeks of this work when there was hardly time to breathe freely and it was like working under fire—only one doctor and an endless stream of wounded being brought in so that to take a moment's rest meant dooming men to death—Samoilovich found an hour "to take a look round" as he put it. He sat down in an overheated room, threw off his jacket and wig and there, in his shirt-sleeves, laid out the numerous case histories in strict order.

He had locked the door so that no one would disturb him.

The evening before, after leaving the monastery, he had been attacked by a crowd of drunkards in a turning near a beershop. It may have been pure accident, for disturbances did occur in Moscow at that time, but it was more likely that the whole thing had been engineered by enemies. Many were the people who had said to him: if you want to put your neck in a noose do so of your own free will, but why force others to torture themselves with plague patients? They will all die anyway, whether you visit them or not.

Samoilovich had been saved by a miracle. He could smile now as he recalled the night tussle and the sudden appearance from nowhere of a fellow-soldier from the Orenburg regiment, a man little short of seven feet, whom he had known during the war. His unexpected rescuer had hurled himself on the crowd, thrown some of them off with his arms of steel and had brought the others to their senses by sheer persuasion.

"What's all this, you frenzied lunatics?! He's our regimental physician! There's not another like him in the world!"

But it had been pretty unpleasant all the same. It was not that Samoilovich felt anger against his attackers. Only knowledge could conquer fear. But once people are told that bad air brings plague from somewhere unknown and that there is no salvation from it, they will even believe in evil spirits.

He read through his notes again. Although his sight was excellent he brought the pages close to his eyes as though only at close range was it possible to read between the lines something that was perhaps most important of all, that had previously not caught his attention. He read through his notes, seeking for the causes common to all these cases of infection, the characteristic features which determined the spread of the disease and the course it took. So far he had noted only one thing: there were some people who recovered from plague but among the patients there were almost none who, having once suffered from plague, became infected a second time. This was a definite and very important observation.

The idea burned like a flame, not very brightly as yet but already throwing a new light on everything. The heaviness he had felt in his head suddenly passed. There had been a sensation of playing blind man's buff, when one is twirled round and round and then pushed about until one cannot tell walls from floor and ceiling; then suddenly the bandage is removed and one finds that everything is in its customary place.

If, once a man had had plague, he was protected against secondary infection, then perhaps there existed some likeness to what takes place with smallpox inoculation. The facts showed that people did not get smallpox after being inoculated. Was it the same with plague? Perhaps the nurses and doctors who came into contact with plague patients willy-nilly inoculated themselves with plague; they got a feeble, imperceptible attack and because of it the disease later was not terrible for them.

A few days later Danilo Samoilovich informed the other doctors of his idea. He wore his usual bland smile, and his sharply defined nostrils were dilated as they might be for taking a deep breath, giving his face a stern, even merciless expression which boded no good to whoever was conversing with him.

"From our point of view," he said, "Mr. Sturmer, who during the whole of the epidemic has done no more than look through a telescope at the patients, is now more likely to get plague and, having once got it, is more likely to die of it than Mr. Pogoretsky who spends days and nights with the patients and, by examining and touching them, willy-nilly introduces pus from the buboes into his body and so becomes self-inoculated against plague."

Continuing to smile blandly he looked straight into Sturmer's eyes for several minutes, inviting him as it were to subscribe to this conclusion and, with the rest, to rejoice that justice sometimes finds a place for itself even in this world.

Sturmer sat breathing heavily and wiping away the sweat which stood out in big drops on his forehead.

No longer smiling, Samoilovich added:

"I think we shall soon be able to show the world that plague is only a contagious disease and that it can be checked without difficulty."

It was not long before the idea spread throughout the world that inoculation could be used against plague, that plague was, or rather would one day become, a disease that can "be checked without difficulty," that by introducing a "weak toxin," the weakened disease organism, into the blood a man could be made safe against infection. Danilo Samoilovich, who originated this idea, was elected a Member of the *Academie des sciences, de l'art et de la litterature* at Dijon and later of the Academies at Paris, Toulouse, Padua, Nancy, Nîmes, Marseilles, Mannheim, Lyons, Mainz and Turin.

One of the largest French scientific journals of the day wrote of Samoilovich: "This doctor has also published another work on plague inoculation and was the first to discover and prove that this operation can be adopted and carried into effect with great success for the protection of the human race."

The first news of the possibility of a determined struggle against plague came from Russia to the countries where not so long previously the black death had reigned, and academies abroad, by one after the other electing Danilo Samoilovich to their membership, thereby expressed their respect for human courage and human genius.

Incidentally, Danilo Samoilovich himself thought little about glory either in the early days when serving in the Koporye and Orenburg regiments and taking part in scores of battles or later, when all his thoughts and energies were devoted to studying plague.

He had to sleep in snatches, measuring the time for rest in terms of minutes; many doctors died and no new ones came to take their place. One night Samoilovich was told that one of the finest doctors and his truest colleagues, Pyotr Ivanovich Pogoretsky, had fallen sick. Samoilovich always walked slowly, his head held high, and he very rarely lost his unruffled calm. But when he heard what had happened to Pogoretsky he did not wait to slip on his coat but rushed from his rooms to the hospital where his friend lay.

After examining and sounding the patient Samoilovich confirmed the diagnosis, but finding that the disease was developing in a lighter form than usual he was somewhat reassured. Throughout the night he remained with the patient, giving him water, changing the ice packs, measuring out medicine. Then he rose and paced the room and, forgetful of all else, argued things out aloud to himself.

"I am sick but it is you who are raving," said Pogoretsky softly.

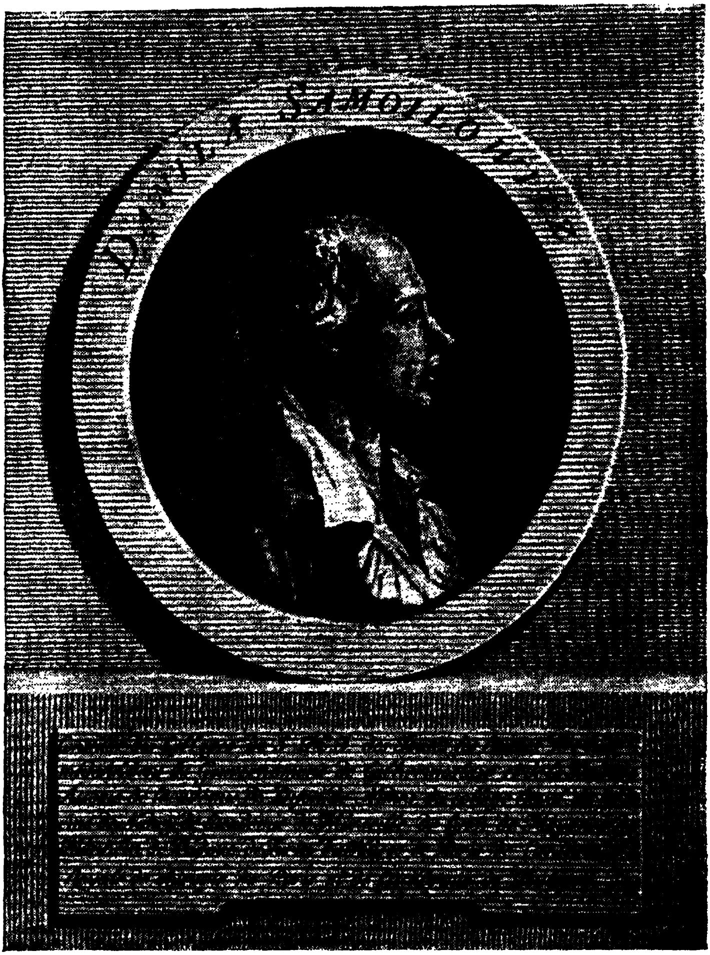
"You are right," agreed Samoilovich, but a second later he was once more engrossed and again pacing the floor, ardently developing his thoughts aloud.

"And that is why," he argued to himself, "we must presume that the disease is transferred by an ulcerous toxin consisting of minute organisms invisible to the human eye. However, one day we shall have microscopes like those used by Malpighi and Leeuwenhoek, or much better than theirs, and then we or someone else will discover the nature of the ulcerous toxin and actually see the carriers of plague. Some day they must certainly be seen. But it is our duty, even without seeing them, to find a means of fighting them, of preventing the toxin from passing from the sick to the healthy. Inoculation can become one of these means, but it is necessary to seek for others. Yagelsky proposed powders for fumigating infected property. It has been said that these powders are harmful to human beings. How can this be said before experimenting with it? But if the powders destroy the ulcerous toxin? Then it will not be necessary to burn down the buildings where plague patients have been housed, to burn all their property; and then people will stop concealing illness. Horror of the disease would diminish and that was the main thing. In this way the power of plague would diminish."

Pogoretsky slept; occasionally he groaned in his sleep. Samoilovich took his arm, and though his mind was occupied with his own thoughts he automatically counted the pulse. No matter what held his attention or what might worry him the doctor remained the doctor; that was the chief thing about him. The patient's heart was beating evenly and the weak but rhythmic pulse reassured Samoilovich.

Three weeks later Pogoretsky was better and left his bed for the first time. Samoilovich helped him across the room to the window. The snow had long melted in Moscow, spring was in the air and the leaf-buds were bursting on the trees in the grounds of the Simon monastery.

"I did say you would get well, didn't I?" Samoilovich reminded him. "When a man has spent as much time as you have close to patients and has nursed them regardless of his own life—and who was more careless of



Danilo Samoilovich Samoilovich

his own life than you?—ought he not, after that sort of vaccination, endure the disease more easily when he does become infected?"

"What are you really pleased about?" asked Pogoretsky, as he stood by the window breathing heavily from the effort he had made. "The fact that I'm alive or that you now have confirmation of your idea?"

"You yourself know the answer. What's more, I thought no less about you than about myself!" replied Samoilovich with heat and conviction. "But is a man glad after the battle only because he is alive? Isn't he also glad because victory has been won? Just remember Lomonosov's mosaic of the battle of Poltava; recall the light shining in the eyes of Peter and those round him. Isn't this our Poltava?"

He thought for a second and then hurried to correct himself.

"But no, it's a long way yet to Poltava; maybe we will not live to see it. But a Poltava there will be."

Samoilovich put his arm round Pogoretsky's shoulders, and said in a low voice:

"I rejoice with all my heart that you are alive, that our idea about inoculation is alive and, most of all, that the idea will help to save thousands of lives."

With Pogoretsky well again, Samoilovich undertook the experiment with Yagelsky's powders that he had planned long before. He used the clothing of a plague victim. Hot, suffocating smoke filled the room where the fumigation was carried out. It made one choke as soon as one entered. Yagelsky looked like a blacksmith, the poisonous fumes had blackened his face while he was concocting something with powders, adding first one and then another substance. Every other second he went into the room where, with fumes belching and sparks flying, the powders burned with poisonous green and reddish flames.

Together with Pogoretsky, Samoilovich walked the monastery grounds, waiting while the preparations for the experiment were completed. Pogoretsky was far more agitated than his friend.

"Won't you let me be first to make the test?" he proposed for the tenth time.

He was older than Samoilovich but somehow he and the other doctors had come to regard Samoilovich as their chief and took his instructions. There was a marvellous strength about the man which was revealed in difficult moments and only in relation to those whom he loved and respected; it was the warm and honest strength of exacting love towards the colleagues with whom he worked.

And so for the tenth time Samoilovich, in the same carefully weighed words, answered the proposal Pogoretsky had put ten times.

"We must have a man for the experiment who can be infected with plague, otherwise how shall we know whether the powders were effective or not, whether they can give protection against plague? You have had plague, so you are no use for the experiment. And no other person can be taken for the experiment because we need a man who believes in the powders and there are only three of these "believers" in Russia: you, myself and Yagelsky. He has tuberculosis, so he doesn't count. And there is nothing more to be said."

Yagelsky pushed the door ajar and announced that he had finished fumigating and the clothing could be taken. His face was stern—an outsider might have said angry—his brows were closely knit, and all because he was very agitated and was trying to conceal the fact. To other people these were just powders with a poisonous smell which burned with a strange green and yellow flame—"hell flames" the nurses called them; but for him they were the greatest thing in life, the result of countless experiments, the sum total of his tremendous labour, the hope that tens of thousands of fellow-citizens might be saved.

Yagelsky's was a hard life. He was seriously and hopelessly ill and he had a suspicious, incredulous nature, but he looked upon Danilo Samoilovich, the first person to support and trust him, as the finest man on earth. Throughout the work of fumigating, Yagelsky had been thinking: "What if the powders do not help and the disease is transferred to Samoilovich through the clothing?"

Samoilovich sensed the agitation in his colleague and guessed the reason for it.

"One can never forgive the man who, without believing in his work, risks the lives of others for his own personal glory, out of sheer bravado. But you have already given your life once and for all to Russia; friends and enemies alike know that. In the battles Suvorov commanded many perished and Suvorov sent many to their death, but on his conscience there is not a single soul that was killed in vain. One's life and the lives of others can and should be risked, if victory, the people, the motherland, require it to be so. And as for this experiment, it was not your idea nor is it in your power to hold me back."

In his own room, Samoilovich stripped himself and put the fumigated clothing on his naked body. The material scorched him.

Samoilovich woke as dawn was breaking. Sleep was out of the question now because the skin burned intolerably. He examined himself and saw that deep wounds had formed on his body.

When Pogoretsky learned of Samoilovich's state, he suggested the experiment be stopped at once.

"You'll die of the wounds, if not of plague."

Samoilovich paid no attention but continued to think his own thoughts aloud.

"If plague does not come from miasmas, evil spirits, divine curses or putrid air, which is what the world has so far believed, but from some living ulcerous toxin, then this toxin should perish under fumigation. The ability to die is the feature common to every living thing."

He was silent for a moment.

"The experiment must not be discontinued," he went on. "You know that as well as I do."

Pogoretsky did not argue, feeling it was quite useless to try to dissuade Samoilovich.

"I just can't understand one thing: how can you stand such torture?" he asked.

"Well, it's true, the pain prevents one from sleeping," replied Samoilovich. "But one gets up, lights a candle, begins to work, and forgets pain."

The experiment was concluded and science acquired one of the first though very imperfect means of combating the spread of plague, splendid proof that plague could be killed and therefore the first evidence, though so far only indirect, of the living nature of the cause of the most serious of all diseases afflicting mankind. With his brilliant idea of anti-plague inoculations based on this general conception of the living nature of plague, Danilo Samoilovich was a century ahead of the science of his time.

Many months after the experiment with Yagelsky's powders, Samoilovich himself caught plague while nursing plague patients.

"I am happy that it has fallen to my lot to test once more the strength of involuntarily produced plague vaccinations," said Danilo Samoilovich to Pogoretsky who kept constant watch by his bedside. "Why, without our experiments the idea of vaccinations would have simply remained imaginary, fantastic descriptions, which leave no mark on the history of science and are of no more use to people than lightning in a drought, which flashes light, but promises no rain."

He breathed deeply and with difficulty raised himself in the bed.

"And I'm also glad because I am sure I shall recover," he added. "I shall not die this summer with nothing accomplished. I need many more years yet."

When the epidemic was over in Moscow, Danilo Samoilovich was sent on an assignment to France and Germany. He was delayed in Marseilles for a few days and there at a picture gallery he and Vasilyev, a young Russian artist, looked at a large canvas depicting a plague epidemic. The memory of the misery caused so recently by the disease was still alive in Europe and this was a striking picture of horror in the face of an uncomprehended and inevitable evil. Dead and dying lay in the little narrow streets of a mediaeval town; a black, threatening cloud hung low over the roofs; even birds perished in the plague-ridden atmosphere and dropped to the ground dead.

"What do you think of the picture?" Samoilovich asked Vasilyev.

"I don't know," the artist slowly replied. "It's well drawn, the artist has a good hand, but—"

"Here the heart is more important than the hand," Samoilovich interjected. "The brush of the artist was guided by horror and fear of something uncomprehended and not by hatred of the scourge, not by courage. When have horror and fear created anything truly great? When Russia defeated her many enemies she also defeated the terrifying bogey which was more baneful than all the warring hordes. Not only here in Marseilles is plague shown on canvases as the most terrible and indescribable calamity, but also in London, Leiden, Paris and many other cities. But surely Moscow has shown that it is possible to fight against this calamity. A different picture must now be drawn. A picture of a sapphire sky over town, fields and countryside, to signify that heavy skies have no relation to plague and that the air is pure even when plague is at its height. A picture should be drawn from which everyone would understand that the calamity does not come from the sky, from all over the place, but passes from one man to another and that it is possible to fight against it, to bar its way."

Danilo Samoilovich encountered plague nine times: during the war in Turkey, in Moscow, in the south of Russia. After each encounter he felt stronger and more confident. One thing alone tortured him: there was no one with whom to share his thoughts and aspirations. Yagelsky and Pogoretsky had died and the young doctors who believed in his work were not at his side.

Samoilovich knew that he had arrived at the very starting-point of the work; what he did not know was who would complete his experiments, read his books, carry out the work he had planned, lead medical science to victory over plague, "to Poltava" as he put it. He was now an old man, he had lost his former energy and by many signs he felt that Sturmer and Dr. Hoffman at the general staff, who had hated him since the days of the Moscow plague, and people close to Hoffman, had not forgotten him and they had power now in St. Petersburg, at Court and in Count Potemkin's circle. When a dispatch arrived ordering him to resign, he did not at once believe it. Unexpected, degrading dismissal! After so many years of work! He put aside his unfinished book and wrote on a sheet of paper in regular, upright handwriting:

"Dismissed from my position. . . . I presume I am as good as dead and all my works, all my beloved science and all the knowledge I have acquired are prematurely buried with me."

He who had never feared disease or foes in battle or death, now experienced such terror, such horror at what had occurred that he felt a pang in his heart and it missed a beat. He mustered the strength he had, rose from the desk and began to pace up and down the room. The movement calmed him and the thought crossed his mind: "Now, indeed, I could do with the soldier from the Orenburg regiment who once saved me from Sturmer's men down the dark turning by Simon monastery."

Because he happened to remember the help that had arrived so unexpectedly during the "Moscow battle" so long ago, he now felt easier in his mind. It seemed he was not alone, what he had accomplished was indeed accomplished and nothing could bury it. The books had been written, the Russian people were a great people, and of the thousands of doctors there would surely be one with a clear head and ardent spirit who would read his books and follow the same road. It might even happen at once, perhaps tomorrow, perhaps in his lifetime, that these people would appear and perhaps only in ten, twenty or a hundred years. But such people would arise.

A man could be removed from his post, killed or buried alive, but not his works, not his clear, "most beloved science."

VETLYANKA VILLAGE

In the first half of the nineteenth century nothing was heard of plague in Russia. But the lull was temporary. The Turkish campaign ended and the Cossacks began to return home. The first to arrive in the Astrakhan steppes was Pavel Zavolokin, an inhabitant of the village Vetlyanka. He returned in the autumn of 1878.

Agap Khritonov was the father of Zavolokin's closest friend, who served in the same regiment, so he invited Zavolokin to his home. They drank from midday till early autumn dusk and made merry, looking in at one home after another with accordion and songs. There was nothing to indicate that calamity was imminent.

A few days later Agap Khritonov fell seriously ill. At first it was thought he had contracted an ordinary chill. But the disease travelled from one home to the next, from one person to the next, and almost every sick person died.

Subsequent reports of the disease which struck the village referred to it as spotted typhus or epidemic pneumonia. Probably the first person to declare the truth was Trubilov, a *feldsher*. He examined a house where all had died. The "mercy-men," full of Dutch courage to fortify them against the horror, and dressed in tar-soaked overalls, were carrying out the dead. Trubilov crossed the yard. Cows heavy with milk were mooing in the shed, the wind banged the shutters against the walls of the house, everywhere was the smell of tar and carbolic and a sickly, cadaverous stench was faintly distinguishable. When the examination was over, Trubilov hurried to the priest Gusakov. The priest was an educated man; at the seminary he had been hounded for being interested in natural science; he had dreamed of going to university, but had finally reconciled himself to his lot and obtained an outlying parish.

Together they sat in silence only rarely exchanging a word or two. When Gusakov's wife left the room, Trubilov said:

"It's plague! We are all doomed!"

The priest did not reply. He had realized without being told the tremendous, inevitable calamity that had swooped down on the village.

Yevdokim Astakhov had been nursing his grandchild, Lyuba. Three days later the old man felt poorly. His head burned and the glands under his arms were swollen. He shut himself away from his relatives in a summer-house.

The following morning the son went to the little window to ask how his father was feeling. The reply came clearly from the room:

"Bolt the door from the outside!"

"Why?"

"I'm very ill. I might lose my senses and come out to you. Bolt it at once! And when I'm dead, don't handle the hay on which I am lying, but rake it into a heap and burn it in the yard. When the 'mercy-men' carry me out, close the shutters and don't come out on to the porch."

There was Dr. Koch, an old army doctor, living in the village. He had been with the Cossacks throughout the Turkish campaign and had remained with them when the trouble came. Koch went from one sick person to another carefully examining each.

"The sound of the heart is muffled, the pulse intermittent," he muttered to himself. The familiar words made him feel easier.

The doctor's fingers lay on the wrist, hardly feeling the faint, sometimes scarcely perceptible, flutter of the arteries. Many of the patients coughed up blood. More and more frequently the thought came to him that perhaps this, indeed, was plague!

He recalled mediaeval engravings: deserted cities, grave-diggers, "mercy-men" in strange masks like the beaks of birds and hooks for dragging out the dead.

"No, it surely cannot be!" Koch persuaded himself.

The doctor was powerless to help, yet he went from patient to patient, as he had done all his life. He sounded them; he gave them medicine. He would not have been able to cure his patients even had he known the disease he was fighting. In those years science had not yet produced any means against plague: the work on anti-plague inoculations that Danilo Samoilovich had begun, had been discontinued when he died, and was forgotten. Koch helped the villagers as best he could with his calm assurance and human warmth.

There, in the Russian Volga steppes, plague tried to start a new European campaign. But the road was barred against it. From the earliest days the disease encountered the greatest self-sacrifice which alone could check its spread.

At the first signs of disease, the afflicted person tried to withdraw from friends and relatives. No one forced this line of action, but people themselves understood that this was the only possible salvation for the rest.

One morning Dr. Koch found he could not get up. As usual he said to himself: "State of depression. I'm just very tired." He felt stifled and his lips were dry, even his voice sounded strange. He thought for a few seconds and then added: "Apparently it's begun." Exerting all his will-power, he got up and dressed and walked slowly down the deserted village streets to the hospital which had been hastily organized at the height of the epidemic. The wards were not heated, snow swept through the broken windows, there were corpses lying on the bunks and no one to carry them away. The doctor found an empty space by the window and lay down on the bunk.

While his mind remained clear he thought of one and the same thing: "Could we have been mistaken and this is plague? How can it be stopped?"

Doctors died with this persistent thought in their minds and new volunteers came to take their place.

By now the village was cordoned off. A ring of hooded Cossack carts some four hundred yards apart encircled the village.

During the third month of the epidemic Chichikadze, chief of the administration offices of Count Loris-Melikov, Governor of Astrakhan, drove up to the cordon line.

Dr. Morozov was urgently called out from the village to the cordon line.

A strong wind was blowing in Morozov's face and it was difficult to hurry. But he pressed on without stopping, for was he not about to see someone from Astrakhan, from the town he now privately called "the world of the living?"

Chichikadze stood about 140 feet from the cordon. He was a cautious man who put great value on his own life. The wind carried to Morozov the irritated voice of the official:

"The Governor is highly dissatisfied. See that the epidemic is stopped! See that some action is taken!"

Morozov's whole body shook; he could hardly control his feelings. It was probably a good thing that Chichikadze, from a distance, could not see his face.

There was a sound of horses' hoofs clattering away over the frozen ground on the outer side of the cordon. The watchman close by sang softly in his hut:

> O, this land of sorrow, this bitter lot of mine!
> Far from home I languish, on Turkish soil I pine. . . .

Morozov stood out in the wind and waited. His agitation and anger soon gave way to weariness. Morozov felt that Chichikadze would surely come back and say something more, that he would give him some messages of greetings, letters from relatives and friends. He could not just ride off in that way. The excitement had made Morozov hot and he unbuttoned his coat. The singing broke off. The Cossack came out of his hut and shouted in annoyance: "Why are you still there, your honour? You're not allowed to stand about!"

Morozov did not reply but looked far into the steppes, lost in snow-white dust, then turned and went back to the village, stumbling as he went over mounds of earth thrown up by marmots. He stopped to rest on the bank of the river. "The river!" he thought. "The river flows through all cordons to Astrakhan."

For a second he clearly saw the native town he had been endeavouring all the time to forget. The sleepy port, the fishermen's boats heaped up with snow, the smell of the sea and the fish. The lights of the ships reflected in heavy, oily waters. People standing on the quayside gazing into the distance or supping in their homes, or merely looking out of their windows at the stars and the lights, with never a care on earth. What a span of life they still had before them!

Morozov continued on his way, hardly able to put one foot in front of the other. His thoughts raced on, sometimes clearly and easily, sometimes confused as in delirium. Did they think of him at all out "there"? They probably remembered: "He's gone to the epidemic." What could the words mean to people who had not seen Vetlyanka?

They did not see the wife of Gusakov the priest, a tortured little woman, who in the last month of her pregnancy was digging a grave for her husband. The woman was breathing heavily and wheezing, but she worked on and on, scarcely able to break the frozen earth with her spade. Morozov would gladly have helped her, but he must not: he had to hurry to the sick. Soon she, too, died and there was no one left to bury her.

They did not see the once noisy, populous Cossack village becoming gradually deserted street by street, house by house.

Morozov was an unknown provincial doctor, and an official from Astrakhan had just informed him that the Astrakhan authorities were thoroughly dissatisfied with him. Was Morozov at any time conscious of the fact that by doing his duty, by not allowing despair and panic to grip the village, by meeting mortal danger totally unarmed, he was performing a tremendous work for the people? It was his courage and that of his colleagues that barred the spread of the epidemic and so saved hundreds of thousands of lives. It was in Vetlyanka that Morozov and other Russian doctors for the last time encountered such a heavy and unexpected onslaught of plague on their own defence territory.

From then onwards Russian science was itself on the offensive in China, India, Arabia, in the Manchurian steppes and Mongolia. It advanced and got to grips with the disease chiefly outside the frontiers of our country.

A silvery strip cut through to the horizon. Everything was pinned down under a hard frost. The cordon separated Vetlyanka from the rest of the world. Morozov walked faster and faster, endeavouring to dispel the gloomy thoughts that had assailed him since the meeting with Chichikadze. Not far off he could already see the dark and empty huts. He found it hard to make headway, his feet seemed to freeze to the ground. The disease was already on him.

A few days later Morozov died.

But all these sacrifices were not in vain. Russian doctors left behind their invaluable observations and gradually liberated science from the heavy mist of mediaeval plague legends.

Grigory Nikolayevich Minkh was born in Kiev and worked for many years studying leprosy. He interrupted his studies because of the plague epidemic and worked in Vetlyanka, investigating the paths along which plague spread. By this time the whole village was in the grip of the epidemic, not a single home was spared.

Minkh sought for the source of the disease. His notes reconstructed the whole history of the epidemic: Here was the first definitely established infection, here the disease struck down the whole family, gained momentum and sent out roots to the neighbouring homes and then finally became the torrent sweeping all before it so that it seemed inconceivable that one could ever find the beginning or the end. As Minkh saw it, the epidemic was something that was clearly visible and almost tangible.

The plague microbe had never yet been described, but the scientist was establishing the laws which governed the existence of the microbe from the cases of disease—the tracks of the vital activity of the microbe.

Minkh made his round of the patients according to a definitely planned route and, after giving what assistance he could, he questioned them about the circumstances relating to their infection. In Khritonov's now abandoned home which Minkh made his headquarters, he put his notes into order: many times he collated dates, facts and names and sought for the laws in the long chain of illnesses. Through the window the light from the lamp would shine late into the night on the large, clearly outlined grey head. From time to time Minkh would straighten his back, remove his pince-nez and rest with his tired eyes closed. He called this "giving himself a holiday." He allowed himself a "holiday" only when he had finished a chapter of his work.

Then he would bend over his notes again. Sometimes he wrote throughout the night until dawn and dropped asleep there at the rough table, his heavy head resting on his arms.

Behind the abundance of collected facts surprising things of extreme importance for practical medicine became revealed. This was the reward for all the labour. Indian or pneumonic plague described by August Hirsch was different in all its outward signs from bubonic plague. Hirsch even considered that pneumonic plague was a special disease which evidently had its own particular causative organism. Yet here it was clearly and indisputably revealed that from people suffering from bubonic plague infection by pneumonic plague could follow. Consequently they were not different diseases caused by different microbes, but merely varieties of one and the same heavy disease. This was a new and important step towards understanding the nature of plague and, it follows, towards victory over it.

When Grigory Minkh had collected a host of irrefutable facts throwing light on the laws of the spread of epidemics, he prepared for the press a serious work on plague, a handbook scientifically correct and passionately human for all those who would continue his work Unfortunately he was unable to publish his book; he had insufficient money to cover the cost of printing. But after his death, his family stinted themselves for many long years, denying themselves every comfort in order to buy paper and pay for the work of the compositors. Finally they achieved their goal and the brilliant scientist's book made its appearance and rendered a great service.

Many years later Daniel Kirillovich Zabolotny made a careful study of the work of his fellow countryman, Grigory Minkh, concerning the Vetlyanka epidemic.

Among the pages carefully analysing precise facts there was the following legend.

"It was said," wrote Minkh, "that Agap Khritonov, who was the first of the Vetlyanka inhabitants to fall sick of the plague, had passed through Nikolsky village a short time before the epidemic broke out. An old man was sitting by the end homestead. When Khritonov came level with him, the old man asked him:

" 'Would you like to have gold and silver? Only it is ill-gotten wealth.'

"Agap replied that he knew of no one who would refuse gold.

Grigory Nikolayevich Minkh

" 'Then go into the yard, you'll dig up the treasure,' said the old man pointing with his finger.

"As Khritonov left with a sack full of gold, he turned to the old man.

" 'How can I pay you for the gifts.' "

" 'You are asking too late. You and yours and those that come after them will pay for the treasure. Only one in seven will be spared in Vetlyanka.' "

A strange legend! Yet there was one thing about it that held the attention: the enigma as to whether, perhaps, it was not the Cossacks returning from the campaign who had brought plague back with them but a man who, as it were, dug the disease *out of the earth* with the gold; the enigma as to whether infection is spread by some other path besides the visible path from one sick person to another.

The legend held Zabolotny's attention for a long time. As he turned the pages of the book he returned again and again to this chapter so different from the rest of the very restrained, precise text. Zabolotny remembered an important observation Danilo Samoilovich had once made during the Kremenchug plague epidemic. The wife of a retired soldier had been among the many people in the town who had caught plague and died of it. Her husband and two children had been quarantined. When the soldier was released from quarantine he returned home and retrieved ten silver coins, wrapped in a piece of material, which he had hidden in the loft before leaving the house. A few days later he fell ill. "The coins struck the soldier a mortal blow," Samoilovich had written.

Minkh's book showed the disease in action. It told in detail of the consequences of plague germs breaking through to the human environment. But two questions remained unclear: what was this plague organism, what microbe caused the disease and how did this unknown microbe penetrate into the human blood, what power set in motion the mechanism of infection so accurately and reliably recorded by Minkh.

These questions had first and foremost to be answered before plague could be conquered.

Danilo Samoilovich had foretold the existence of a plague microbe during the Moscow epidemic in the seventies of the eighteenth century. All his life he had dreamed of seeing the living source of the disease. In 1784 the scientist had on his work-table a Dellebarre microscope, one of the finest and most up-to-date microscopes of the day. He entertained the highest hopes concerning this microscope, but his hopes were not justified. The instrument magnified 1170 times, but when the object to be investigated was magnified more than a hundred times it became greatly distorted. Samoilovich made tireless observations; he made his own slides, but the Dellebarre lenses were far less up-to-date than the ideas of the scientist. The existence of the plague microbe was foretold in the eighteenth century, but it was only possible to see it a century later. During the years of the Vetlyanka epidemic, Professor Euchwald of St. Petersburg Army Medical Academy saw the plague microbe.

A few years later than the Russian scientists, in 1894, Kitazato, a Japanese scientist working in the Hongkong epidemic and almost simultaneously Alexandre Yersin, a French scientist, described the microbe which caused plague.

But even after the plague microbe was discovered the most important thing still remained unknown: where do the plague microbes exist during the decades which often separate one outbreak of the epidemic from another; whither do they vanish and what are the conditions under which they again break through to the human environment?

Minkh considered that Zavolokin had brought plague to Vetlyanka from the Turkish campaign. Why was it that outbreaks of plague-like diseases also occurred from time to time in other more distant parts of the Central and Lower Volga regions, though they were in no way connected with Asia Minor?

All this required deep and careful study. This was still only the beginning of the work which occupied whole decades and for which a high price was paid—the lives of many research scientists.

"Our science cannot and must not wait until an epidemic breaks out in Russia," thought Zabolotny. "The danger threatening our country is too great. The secret haunts of the plague microbe must be tracked down and the microbe destroyed where it is in hiding. This is possible and this is essential!"

THE FIRST WEAPON

The disease flared up in India in 1896. It began on the outskirts of Bombay in the poor districts adjacent to the warehouses. People fled in horror from the stricken districts. The plague spread with menacing speed throughout Bombay and broke through far beyond the town, spreading along the wooded slopes of the Western Ghats.

Russian doctors decided to send a group of specialists to work in the epidemic area and so help the neighbouring country.

Daniel Zabolotny was glad of the unexpected proposal that he should be one of the expedition. He wanted to test his powers in the struggle against this most dangerous and perhaps least studied disease in the world.

Zabolotny read everything about India to be found in the library. He made detailed notes about the customs, ancient caravan routes, death rate statistics and the amount of precipitation. The notes in his notebook followed one after the other in apparent confusion.

"The order of rodents is extremely abundantly represented, the mice family (Muridae) is particularly rich in genera and species, the rat known as bandicoot is widespread here."

"From Bombay ships make regular trips to Colombo in Ceylon, Zanzibar in Tanganyika, Aden and Karachi."

"The belt of most abundant precipitation—99 inches annually—passes along the coastline."

"Famine is the most terrible scourge affecting this vast country. The English have inundated India with cotton fabrics and in Dacca, the ancient centre of Indian weaving, only 20,000 remain of the original 150,000 inhabitants; the rest either died of famine or fled. In 1741 five million people, being one-third of the population, died of famine in the single Indian province of Bengal. In 1874 there was famine in Bombay, Madras and Hyderabad. Between 1874 and the middle of the nineties more than 20 million Indians died of famine."

Zabolotny did not as yet know in what way all this might be of use. But he did know that it certainly would come in useful! He knew that epidemics formed a tangle involving the whole life of the country. The epidemic could only be combatted by unravelling the tangle.

Only when he was about to leave for India did Daniel Zabolotny inform his closest friends and relatives of his plans.

"A doctor has no right to miss such an opportunity!" he said firmly.

"But why are you so drawn to foreign countries?" asked one of his colleagues. "We are badly in need of medical help here at home in Russia."

Zabolotny stepped over to the map of the world hanging on the wall and drew a long line from Bombay, past

Aden, through the narrow neck of the Red Sea to the Mediterranean and Black seas and our own shores.

"It is our duty to meet plague at the beginning of this road if we are not to see it in Russia."

The Russian medical expedition set out for India in the early days of February. The evening before his departure Daniel Zabolotny went out to bid farewell to the city. There had been a sudden rise in temperature the day before and spring showers had poured down intermittently since the morning. On Vladimir Hill Zabolotny broke off a branch of poplar and rubbed a swollen leaf-bud between the palms of his hands. It produced such a strong scent of poplar that it was as though the leaf-bud contained spring itself which had now been released and filled the air. The ice had not yet broken on the Dnieper and in the darkness of early evening the river shone below the high bank—a still, silver-white stretch of ice. But rivulets of rain water gushing over the cliff-edge in waterfalls and rattling on the pebble below gave the impression that the ice must be on the move. Daniel Zabolotny returned very late to his small room in Bessarabia Market. He paused for a few minutes on the porch and filled his lungs with the warm, humid air as though to take with him on his difficult travels at least one tiny particle of the early Kiev spring. That night there was no opportunity of sleeping. He packed his luggage and talked with his wife until it was almost dawn. This was to be their first long separation and who could tell how long this work against the epidemic would last. He tried to sleep when Lyudmila dozed but could not. He got up and sat at the table.

Of late, ever since deciding to join the expedition, Zabolotny had thought a great deal about the future and had put himself to a severe test. Now he was quite sure that the Bombay expedition was not just a casual episode in his medical work but the beginning of a life work.

He knew he had made his final decision and the direction he had chosen would be his for many years to come.

Hundreds of people assembled at the station to see off the members of the expedition, Professor Visokovich, Dr. Rednov and Daniel Zabolotny. There were university lecturers, doctors and particularly large numbers of students. The brass band of the 132nd Bendery regiment where Zabolotny had served as junior physician, played marches throughout. The trumpeter, an elderly soldier fulfilling an extra term of service in the regiment, a man who was painfully nostalgic about his family and usually put all his hopeless longing into his music, on this occasion played with inspiring cheerfulness. The drummer, a fourteen-year-old lad who dreamed of leaving army service and studying "to become a physician," beat out the tact with such energy that at times he completely drowned the other instruments. Zabolotny was personally acquainted with each member of the brass band and every soldier in the 132nd Bendery regiment. Because of this he seemed to hear in the thundering of the brass band that filled the platform, the human voices of the men of his regiment who had needed his help, had asked his advice, and were now wishing him a happy journey. Who could tell whether the trumpeter would really be happy when he rejoined his family in the soldier's hut now fallen into ruin after long years of absence? Who could say whether the drummer, a talented enough lad but with a weak chest and the first stages of consumption in his lungs, would ever break away from the regiment and really study, and in any case who could tell how many years he had to live?

More and more people, some scarcely known and some quite unknown, pressed round to say good-bye, to shake hands, to say a few words of cheer on their departure. The third bell rang and the members of the expedition kissed their relatives and took their seats in the carriage.

Suburban stations and fields now almost free from snow passed by. Before them they had long days of journeying, first across their native land, then over the sea.

The Russian anti-plague expedition arrived at last in Bombay on February 28, 1896.

The town appeared to be dead: more than half of the population of 800,000 people had fled. There was not a soul in the streets. The doors of the houses were chalked with rings to signify that sick people lay there; where the ring was crossed out, the sick had already died.

There were empty huts on the outskirts, where the Sudras, the poorest caste of Indians, lived; there the disease had annihilated everyone it could. The roofs had been removed to let the sun penetrate to the dampest corners and drive out infection. But even the sun did not help. It seemed that plague had concluded an alliance with the rich; it destroyed almost exclusively the inhabitants of the workers' districts of the town. In the days of the Bombay epidemic N. I. Westenrik, junior physician of the 17th marine detachment, wrote that "a quarter of the sick were servants, then came unskilled workers and coolies, then washermen, tailors and barbers." Two or three thousand people died each month in Bombay.

The most depressing part was the feeling of impotence. The plague microbe, an immobile rod-like bacillus with two light poles, lay there under the lens of the microscope. It was now visible, but did that make man stronger in the struggle against it?

Cultures of plague microbes were grown in laboratories on special nutritive mediums. Under the microscope the colonies of microbes looked like dark flowers with regular oval petals, something like phlox. Sometimes in one or other part of the culture still darker islets appeared: there the microbe, for some reason or other, was multiplying more rapidly and scientists called these formations "cannibal colonies." And indeed, the bacteriologists were observing organisms which had full and indisputable right to be called man-eaters.

By this time scientists knew the "habits" and living features of the plague microbe. They could kill it at will by heating it or by other means or, on the contrary, they could accelerate the growth of the colony—cultivate microbes. They could weaken or strengthen the virulence, the disease-producing power of the plague microbe. But they could do all this only in the test-tube and not in the blood or the body of the patient.

Outside the walls of the laboratories the disease continued to pass from one person to another and the leucocytes, the white blood cells that are the defenders of human life, retreated before it. The microbe still killed people as easily and surely as it had done a century previously.

Seeing the enemy did not yet mean defeating it. Rings were still chalked on the doors of houses, as many rings as there were sick people inside; and a few days later crosses covered the rings, registering the toll of death.

People were dying as before, but only to an outside observer could it appear that nothing had changed. With the arrival of the Russian expedition the forces of man in the struggle against the epidemic increased with every passing day. Each doctor worked in two shifts: by day in the hospital, at night or in the evening—in the laboratory.

Passing through the city at night one would see suffocating mists hanging motionless over the houses and enveloping the whole town; all round was darkness except for the lights from the laboratory windows. Sometimes a shape darted across a window-pane, a window was thrust open and low voices were heard. Then all would be still: the people had left the laboratory, some to sleep, others for night duty at the hospital.

Besides working against the epidemic and doing everything possible to save the townspeople from the terrible affliction, Zabolotny set himself considerably broader tasks. For him Bombay was primarily the place where the infection had broken out and had then spread through India and threatened Russia and the rest of the world.

Plague had gone into hiding but Zabolotny knew that sometime he would meet it face to face, here or a thousand miles away, now or within ten or twenty years. Only a short time previously he had attained his thirtieth year and he believed that he still had enough time to engage in a general battle against the power which had already destroyed hundreds of millions of lives.

Just as for the doctor the lymphatic gland swellings indicate the paths of infection in the body of the patient, so Bombay and Vetlyanka, Arabia and the Mongolian steppes were, for Zabolotny, the lymphatic gland swellings, as it were, the tracks of the movement of the microbes in the organism of mankind as a whole. And it was necessary to track down this movement, to cure not one person, one town, one country, but to cure the whole world and first and foremost the countries which threatened Russia. Daniel Zabolotny was engaged not on a particular, but on a general task, and he believed in the possibility of its complete solution.

* * *

Vladimir Khavkin was a man of a totally different mould. He was a practical-minded scientist and he concentrated all the forces of his mind on clear and visible aims; he sought for a weapon which doctors could use in their practical work. It might not fully decide the outcome of the battle, it might be only one step towards the goal, but the main thing was that it should be of use in assisting people at once, without delay.

On the morning of January 10, 1897, Vladimir Khavkin began his experiment. His idea arose out of the struggle against other epidemics. It had been proved that if the bodies of dead microbes are introduced into the blood of a human being, then in the course of overcoming the toxin the human body increases its resistance to the disease, that is to say, it acquires immunity to a greater or lesser degree.

This had been proved with several infections but not with such a dangerous and little investigated infection as plague.

"You're taking a very big risk," said Dr. Surveyer, Vladimir Khavkin's assistant and one of his closest friends, a man who was working with him during the Bombay epidemic. "More than a risk, even," he added. "Why, we actually know almost nothing about the biology of the plague microbe."

"And yet I'm convinced that the experiment is planned correctly," objected Khavkin. "What's more, you agree there's no time to waste. Thousands of people are dying and here we are absolutely powerless and incapable of rendering any real aid."

The preparations began for the experiment. Drops of oil were added to the nutritive broth to stimulate the growth of microbes. The microbes divided and multiplied with astonishing rapidity. They formed a ring round the walls of the vessel and covered the bottom of it; a thin film of microbes also covered the under surface of the nutritive medium; they seemed to cling to the drops of oil and hung suspended into the depths of the turbid liquid like numerous stalactites.

The scientist now had a sufficient quantity of microbes at his disposal. Before introducing plague into his blood, he had to kill it. Plague microbes easily resist freezing; they can exist for more than a month at a temperature of minus 20° C., but heat is fatal to them. It is enough to raise the temperature of the liquid medium containing microbes to 50° C. for them to be rendered harmless after forty minutes; a temperature of 60°C. affects them in the same way in two or three minutes, and a temperature of 70° C. almost instantaneously.

Vladimir Khavkin closely watched the mercury rise slowly in the thermometer.

Forty, fifty, sixty and at last sixty-five degrees!

The high temperature had by then killed the plague microbes, but it had not destroyed the poison contained in them. The dead but still dangerous enemy was in the hands of the scientist.

There was nothing at last to delay the experiment. Dr. Surveyer agreed to assist; he alone was to know of the experiment. Otherwise there would have been interference, demands for more tedious experiments on various kinds of animals, for more careful preparations, and Khavkin considered it would be an unpardonable waste of valuable time to delay further.

The vaccine was introduced into Khavkin's right side and then the left.

Very soon the scientist felt the fever on him. Eight hours later the temperature rose to 102°. There was a sharp increase in the fever condition.

Khavkin continued to work, stopping from time to time to jot down a description, in his notebook, of the symptoms of the struggle between his body and the plague toxin. For he had explained to his colleagues that the experiment would only be of value if an exact and detailed record were kept. There was no reason for any departure from the old rule. Experimenting on oneself has one great advantage, for how else can one not only see and measure the whole development of the disease from beginning to end but also feel it all, internally. It would have been a crime not to make the fullest use of this fortunate advantage.

Hour by hour the temperature, pulse and rate of breathing were recorded in accurate columns on a sheet

Vladimir Aaronovich Khavkin

of paper. Dr. Surveyer was at hand throughout. From time to time he would bend over the table and closely examine the entries in the note-book.

"It's going very well," said Khavkin noting the alarm in his eyes.

"The reaction is strong," he went on to elucidate. "All the more reason have we to count on the formation of stable immunity. The organism is fighting."

A moment later, replying to his assistant's unspoken question, the scientist added:

"And it will be victorious!"

The temperature, meanwhile, continued to rise.

In the evening there was a meeting on the question of combating epidemic. Khavkin attended it. He appeared at the meeting carefully shaved, as was his custom, and wearing a clean white overall. His hair, which had recently turned from black to grey, was carefully parted and brushed back revealing his prominent forehead. The eyes under the thick brows had an expression of deep concentration. Only Dr. Surveyer knew, while Khavkin was calmly outlining the measures required for the speediest organization of hospitals and speaking perhaps a little more slowly than usual, that every word he spoke cost him great torment. For the experiment was at its most acute stage and it was impossible to guess what the outcome would be.

During the days that followed, it became clear that the experiment had been a success and the life of the courageous scientist was out of danger.

This was one of the first and most splendid victories in man's struggle against plague. Thus, in 1897, Russian science carried out the brilliant project suggested by Danilo Samoilovich who more than a century earlier had foretold the possibility of inoculating against plague.

* * *

Khavkin's method of vaccination with dead plague microbes became widely used. It halved the amount of plague sickness and reduced the death rate to a quarter.

But tens of thousands of patients who had not been vaccinated in time were brought into the hospitals. Khavkin's vaccine had no positive effect on these patients. On the contrary, the vaccine frequently lowered the resistance of the organism when introduced into their blood.

Doctors then began to try out another method of treatment. There are some animals which are not killed by plague. When plague microbes are introduced into the blood of the horse, for example, they have to retreat for they encounter strong resistance. The protective forces of the horse's organism are immediately set in motion and produce special immune substances which ensure victory over the disease-creating microbes. The plague microbes are killed, but these substances remain for a long time in the blood stream. What if an attempt were made to use them for a second time to aid sick people? This simple idea formed the basis of a new method for treating plague.

Doctors made a serum from the blood of an animal which had conquered the disease, with a view to injecting it into a patient suffering from plague.

Before using this method in the hospitals, it was studied in laboratories with monkeys. The first experiments on injecting anti-plague serum into plague-stricken long-tailed macacos gave promising results: the disease took a lighter course and there was a reduction in the number of animals that died.

While at work in the laboratory Zabolotny did not think that a few years later a "lucky chance," as he later put it, would allow him to test on himself and confirm the curative effect of the serum.

And so in Bombay science—primarily Russian science—repulsed the plague onslaught. The town came to life again, the narrow streets filled with people. The disease had gone into hiding, it had retreated, but at any moment it might break out again. It was necessary to discover where the plague could be expected to appear next time, after how many years, on which continent and in which country.

Only by tracking down all the paths taken by the epidemic would it be possible to find an answer to these questions.

INVISIBLE CURRENTS

Zabolotny marked on the map the districts where the disease was appearing year after year.

For ages there had been plague in Mesopotamia. This ancient country lies at the cross-roads where the Moslem pilgrims from Iran meet those from Asia Minor, when they make their pilgrimages to the sacred Arabian cities of Mecca and Medina. Sometimes disease was carried along in the human torrent and swept through neighbouring countries only to return once more to its old haunts.

In the Southern Himalayas, ten days' journey from Bombay, the people were dying of a disease they called *mahamari*.

In the depths of Africa, not far from Uganda, there is the little studied region of Kisiba. There a disease called *lobunga* destroyed whole tribes.

There had been suggestions that behind these local names—*mahamari* and *lobunga*—the same plague was hidden.

Pilgrims travelled from Weichang to Urga in order to bow down before Khutukhtu, Mongolia's highest Buddhist God. On the way they met their co-religionists, the nomad Mongols. Sometimes a pilgrim carried the deadly disease home with him. When he died, his body, according to Buddhist custom, was laid out in the steppes on the ground. Birds of prey—eagles, hawks, vultures and kites—flew in to feed on the corpse; the earth became soaked with blood that was saturated with microbes.

There was now one link only missing in the cycle of disease: how the earth preserves the living causative organism, how it passes it back to man. For if the plague microbe were left for a long time outside the living organism, it should perish.

Chemists, we know, have discovered that substances which are not outwardly similar, diamonds and coal, for instance, are nevertheless only different forms of one and the same element, carbon.

Bacteriologists now had to prove that there was only one thing that caused plague, *lobunga*, *mahamari* and many other diseases, and that was the plague microbe.

Hydrologists have followed the underground rivers which flow under the sands through the Hungry Steppe and feed the great lake Balkhash. Bacteriologists now had to find the invisible currents of the causative organisms of disease which helped plague to penetrate into the human environment.

There are three towns in the Near East which form an eternal human whirlpool. They are Mecca (otherwise known as "the Holy City," the "Waterless Town," the "End of All Strivings"), Medina (the "City of Light") and ancient Jedda.

From countries where cholera, leprosy and plague were widespread people streamed to these places on the shores of the Red Sea, in rocky, sun-baked Arabia. It is possible that the pilgrims passed on infection at the places of worship in the "City of Light" and that other city which had acquired the name of the "End of All Strivings." Where else could one track down with equal accuracy the laws governing the spread of epidemics?

This was how Daniel Zabolotny conceived the original idea of taking a journey along the paths of the spread of dangerous diseases.

The scientist mingled with the endless human torrent. Crowds of people speaking various languages filled the roads. There were the *Mograbians* from Africa looking furtively from side to side with their weapons hidden in the folds of their clothing. There were bronzed Indians and Syrians. First they tramped on foot and then travelled by boat, huddled together on deck, looking impatiently into the distance.

At night bright tropical stars burned overhead and the sea became a vast expanse of shimmering, living light, rocked by the waves, caused by luminescence from myriads of microscopic sea plants. The ship seemed to be sailing on waves of light. The luminescence was intermittently bright or dim. Emerald, amber and ruby sparks glistened in the white foam at the ship's stern. It was difficult to tear the eyes away from this bounteous, tropical brilliance.

The people lived a life of their own on deck: the *hadji* prayed, his face turned towards Mecca; the pearl-divers stood motionless by the side of the boat, as though carved from shining ebony.

Sometimes there was grief and mourning on board: a Moslem pilgrim on his way to the sacred places died without reaching the "End of All Strivings" of which he had dreamed all his life. His co-religionists performed the burial rites. The body was wrapped in a white shroud and thrown, with a heavy weight, into the sea. There was a splash, the shining surface of the waters was momentarily disturbed, then the cold luminescence again rocked smoothly.

Zabolotny was at work. He questioned pilgrims and late at night in his cabin wrote down the names of the places from which the pilgrims had started, the ports they had entered and the purpose of their travels. From the isolated notes the main human torrents became more and more clearly defined.

In his textbook which contained carefully written notes, the scientist also jotted down all he saw: coastal towns, unfamiliar customs, the luminescence of the sea.

Zabolotny had always hated death and it was this feeling that now shut out everything else. He was getting ready for a determined battle with death and he began to think the enemy was not at all so powerful and invincible.

Zabolotny knew that statistics put the average span of human life in China, India, British Gambia and many other countries at not more than twenty to twenty-five years. Millions died in the first months of their lives, killed by epidemics and famine. But early death from disease is not a permanent law of nature.

Humanity was dreaming of immortality. The ancient dream might never come true, but could science not curtail infant mortality, destroy the centres of the most dangerous diseases and so, by making our planet healthy, double and even treble the span of human life?

The ship reached Jedda in the day-time. The whiteness of the buildings huddled on the shore was blinding to the eyes. High minarets were clearly outlined against a blue sky, the flat-roofed houses with latticed balconies lay dozing in the sunshine.

Once the shore was reached, the snow-white vision immediately vanished. Dirt and poverty prevailed in the little winding streets. Women baled stale water from rain-butts. Everywhere there were crowds of beggars, hands outstretched, silently soliciting alms. There were frequent outbreaks of mortal disease in the town.

Zabolotny carefully analysed all he saw, and time and again read through his notes. Gradually Arabia's tremendous epidemiological importance for the world was borne in upon him. It would have been more correct to call the "City of Light," the "City of Death."

The entire Moslem world sent pilgrims to Arabia. Merchant caravans travelled from Basra to Damascus. The dead, who before dying expressed a desire to find eternal peace on sacred soil, were brought from Turkey to the lowlands of Kerbela and Nejf. Every year tens of thousands of pearl-divers travelled to the shores of the Persian Gulf.

Zabolotny drew a map of the roads followed by these human torrents. They intersected and formed clumps and whirlpools on the shores of the Red Sea. The question of how infection spreads had to be decided like a geometrical problem, by seeking the laws governing the complicated, interlacing lines.

The map began to reach completion. Zabolotny was the first scientist in the world to map out the plague front from the Himalayan Mountain Range to Africa, from India to Mongolia. He was not covering separate sections or epidemic outbreaks, but the sum total of forces, the full measure of the danger. He was investigating the paths along which plague spread and the areas from which the disease threatened the world.

Zabolotny's expeditions covered the whole of Asia. The routes he followed lay north to south, south to east, west to north-east. When a superficial investigation had been made of the southern front of the infection menacing Russia from the Caspian area, Zabolotny contrived to organize an expedition into the Trans-Baikal areas.

Only scrappy and incomplete information was available from Mongolia, Manchuria and China concerning the state of epidemiology in those countries. Exact information was required as to which microbes could penetrate through the wall of the Sayan, Yablonovy and Stanovoy ranges by passes, caravan routes and the tracks of wild beasts.

There were only two people in the expedition: Daniel Zabolotny, who was in charge of it, and Taranukhin, a student. From the outset there was so much work on hand, so much material accumulated by local doctors which was often complicated and contradictory, such a collection of vexed questions, that their minds were constantly occupied with the problem as to how to avoid drowning in the sea of facts and losing sight of what was most important.

When the work was at its height in June 1898, the post brought the latest issue of the *Medical Gazette* from St. Petersburg. It contained one small striking paragraph: a report that according to information collected by the physician of the French Consulate in Peking there was a place in the Khingan mountains which was the centre of some unknown, extremely infectious disease which usually caused death.

Previously only one world centre of plague had been studied bacteriologically: this was in the heart of Africa near lake Uganda amidst swampy lowlands teeming with rats. If this disease, so vaguely described on the basis of eyewitness reports by a French doctor who had never himself visited the place, was caused by the plague microbe, then investigations had to be made into how it had penetrated to the alpine meadow belt of these mountainous plateaux and had become established there.

Taranukhin slept on his bed of straw, covered with a rough linen sheet, his head resting on his army-coat rolled soldier-fashion. There was an expression of unruffled calm on his frank, sleep-flushed face. It almost seemed as though, if one peered closely into the gloom that filled the hut, one could see his dreams floating above his head. And what dreams would they be after many days' work for sixteen and sometimes twenty hours on end without rest: the journey home, St. Petersburg and Moscow, meetings with close friends and relatives, the Bolshoi Theatre, Vorobyovi Hills, white hawthorn and the Moscow River!

"Sleep while you may, young fellow," thought Zabolotny. "We've a long time to wait, days, perhaps months, before your dreams come true."

On the table lay a map of Siberia, Outer and Inner Mongolia. Zabolotny's pencil crossed the Yablonovy Range, passed between Baikal and the blue winding Shilka and plotted out the road to Kyakhta and Urga, crossed the Gobi Desert and followed Przhevalsky's routes south-east to Pekin and north to the mountains.

Two thousand kilometres on foot and camel...

Immediately after reading the *Medical Gazette*, Zabolotny sent a telegram to St. Petersburg requesting permission to undertake a new expedition. Later Zabolotny jokingly called it the "psychological document." It contained only a few words about scientific expediency and the need to undertake the expedition, and a great deal about how the affair would not cost much, no fresh equipment would be required nor any additional staff, except for an interpreter; horses and camels could be obtained at little expense. It concluded with the reminder that the public at large would undoubtedly fully approve of the undertaking.

Taranukhin slept. It was almost dawn when Zabolotny lay down at the very edge of the straw bedding so as not to disturb the sleeper.

The telegram was already on its way to St. Petersburg. There the "psychological document" had its effect. St. Petersburg needed loans, and this scientific expedition could in some measure contribute to the acquisition of prestige. If the camel Zabolotny's expedition required could bring the slightest prestige, and the camel was cheap, then why not sponsor the expedition?

Zabolotny woke Taranukhin the next morning.

"I've become very attached to you, young man," said Zabolotny, "but if you are overtired, I could try and find another companion, you know."

"Oh no, I'm coming with you, Daniel Kirillovich," objected Taranukhin firmly. "I'm going wherever you please, wherever you suggest."

"Even to the moon?"

"Even to the moon if there's plague there."

They began their preliminary preparations at once. Bimbayev, a Mongol, was to be the interpreter and he advised delaying the departure for a few weeks: it was hot in the Gobi Desert now and there was hardly any sense in going, everything was scorched. It was not so bad when the weather was calm, but soon the winds would begin to blow and there would be sandstorms.

Zabolotny listened attentively nodding his head, as though he agreed with Bimbayev. Then he suddenly asked a question.

"But listen here, Bimbayev: if mortal danger threatened your best friend and you had to take the road at once, to save his life, what would you do?"

Bimbayev was a man of few words and only spoke when he felt it absolutely essential, and then only after much thought.

"Has the chief a friend there?" he asked, turning to the window and pointing vaguely to the east where the greenish-blue wooded foothills, which seemed almost black in the far distance, could be seen.

"The chief has friends everywhere. Isn't that so, Daniel Kirillovich?" interjected Taranukhin with a smile.

From that moment the final preparations for the journey began. The day permission arrived from St. Petersburg, the expedition set forth. They proceeded without rest, in spite of the exhausting heat, and covered twenty-five to thirty miles a day. When they arrived at Urga, the mobile laboratory was loaded on the camels. Slowly and solemnly the expedition passed through the deserted streets of the town. For once, Zabolotny, who was usually eager to hurry forward, seemed disinclined to leave the town. He frequently stopped to run off into side turnings without warning Taranukhin. After one of these absences he came back, his face beaming and his arms full of carnations and tea roses, all he had been able to find in the only flowershop in the town. The camels looked idly round and indifferently sniffed the strong, sweet smell.

The wind blew hard across the desert, raising clouds of sand. The air seemed so dense that one had almost to cut one's way through it.

The expedition moved directly eastwards, halting only to study districts close at hand and give assistance to the local population. When a halt was made, the expedition split into two groups, to cover a wider area, the "reconnoitring party" consisting of Zabolotny alone, the "main force" comprising Taranukhin and Bimbayev.

Sometimes the "reconnoitring party" travelled many miles off the main route in two or three days, taking the mobile laboratory with it. Zabolotny's tangled reddish hair was bleached almost the colour of straw, his face had become lean and bronzed, but his blue eyes shone boldly and merrily as always. He wore his army jacket of the 132nd Bendery regiment fastened carelessly on a couple of buttons. The cloth had faded completely under the Indian, Arabian and Mongolian sun, except for the two sweat-stained patches at the shoulder blades. The "reconnoitring party" travelled from one nomad camp to another in search of the sick, striving to break into the "plague fortress" and to understand the structure of the plague death repository.

* * *

If the causative organisms of the disease passed only from one human being to another, then having killed the last person in their path in a particular locality, the microbes themselves should then cease to exist. But for millions of years bacteria had been adapting themselves to the changing environmental conditions. The microbes of many most dangerous diseases make the complicated journey not in space, not from one country to another, but on one and the same restricted territory, passing from one species of animal to another. This path of infection, when the virus does not go beyond the bounds of wild nature, can be called its "minor cycle."

People who have penetrated the depths of the Far Eastern taiga suffered from taiga encephalitis—an inflammation of the brain which is dangerous to life Years of heroic labour were spent before Yevgeny Pavlovsky and other Soviet scientists deciphered the "minor cycle" of the movement of encephalitis, discovered its natural haunts and proved that the tick which lives in the taiga introduces the virus of this disease into the blood when it bites a human being. The infection existed before, but it would now be visible and would pass along the "major cycle" which includes mankind.

During the years of the first five-year plan, when building began on the desert shores of Vakhsh in Central Asia, doctors observed the appearance of a serious disease which was a special variety of Leishmaniasis. Soviet scientists succeeded in establishing that the jackal is one of the links in the movement in nature of the Leishmania.

In this way scientists are investigating the limits of the spread of one or other microbe. In taiga, forests, steppes, deserts, mountains, swamps, wherever human beings live or will live, this work is in progress. Scientists are discovering the invisible, well-concealed haunts of the enemy. They are laying bare the repositories, the reservoirs of the disease-creating microbe in order to protect mankind from it.

In the hospital, the doctor treats the man who has already fallen sick. He uses medicines to assist the patient's organism in destroying the microbes which have entered the blood and begun their destructive work. Soviet science is pursuing a more far-reaching aim: it is endeavouring to prevent microbes completely and for all time from having any access to the human environment, to destroy them before they come into contact with the human being, to destroy the very possibility of sickness.

Soviet doctors are abolishing malaria by draining swamps and using aeroplanes to spray chemical substances on malaria-infested localities and so destroy mosquitoes. In all the main centres of malaria throughout the entire territory of our country, this exhausting disease, which afflicted millions of people, is almost entirely wiped out. As they master the depths of the taiga, scientists are destroying the haunts of the tick which carries the virus of taiga encephalitis. They find and destroy the natural bases, the secret natural haunts of the microbes which are the sources of infection.

Sometime in the future when communism is victorious over the whole world, scientists will strive to achieve what is at present a dream: they will study and destroy all the centres of dangerous microbes to be found on our planet. This will not come about all at once. Gradually one disease after another, together with the natural disease-carriers, will vanish for all time even from the memory of mankind.

Daniel Zabolotny was one of the initiators of this splendid trend in science. Almost nothing was known of the paths along which plague was spread, before Zabolotny made his investigations.

In British ports one can see large metal rings on the hawsers running from the ships to the quayside. During the night a rat may slip, a grey shadow, from deck to hawser, run along it as far as the metal ring, then turn back, baffled by the obstacle it cannot pass. Rings of this kind have been used on ship's hawsers ever since it was proved that plague attacks rats and that rats carry it from one port to another.

In Mongolia, where Zabolotny had arrived, there were no port rats. There was endless desert steppe: rolling hills stretching wave-like into the horizon, alternately revealing and concealing the lone rider. Occasionally one caught a glimpse of the reddish-sandy-coloured *dzeren*, or steppe antelope; sometimes a black crane, balanced on one leg, gazed incredulously at the dark silhouette of the distant rider; the desert hare cocked its ears, alert; the black kite noisily flapped its wings overhead; the strange, big-eared hedgehog scuttled by.

Which of these animals concealed plague?

Turn your mind back to the story of the ill-gotten gold and the plague outbreak in Vetlyanka. Out there in Mongolia Zabolotny learned of another tale which was astonishingly like that recorded by Minkh.

Not far from Urga at the Khushun-Mikhar boundary mark, Chinese and Mongolians unearthed a treasure. A few days later twenty of the men who had dug up the gold and silver died. A lama from Tirsa, who had been given a few precious metal bars for his monastery, also died.

It is hard to believe in some curse on the treasure or in evil spirits guarding it. Yet people were actually seen to die; this was no fairy-tale.

The idea that had come to Zabolotny many years previously now completely engrossed him; the spread of plague was connected with the earth, with the steppe, or rather with the animals which inhabit the steppe.

The treasure-finders had inadvertently come into contact with a sick animal which had its burrow close to the treasure. They had probably been unaware that they had touched the animal, but apparently seconds were sufficient for the carrier of infection to pass it on to man. Plague had gone beyond its "minor cycle."

The danger was concealed in the earth. Perhaps not only rats but also their distant relatives, the steppe rodents, transmitted the disease to man.

Zabolotny was particularly suspicious of one species of rodent: the Mongolian marmot or *tarbagan.* It is found over vast expanses from Hingan to the Urals. It burrows in the steppes and even in mountains at a height of as much as 14,000 feet above sea level. During one of his travels, N. M. Przhevalsky, the great Russian explorer of Central Asia, found the Mongolian marmot in the neighbourhood of the Marco Polo Range and the Koko Shili Mountains of the North Tibetan Plateau.

It is easy enough to recognize the domain of these rodents: numerous mounds of earth on the hill-sides thrown up by the animals when they make their burrows. The marmot is strong, cunning and indefatigable and can make its way through rocky soil, hurling aside bits of granite sometimes several pounds in weight. The animal "paves" the area in front of its burrow with earth and sand and there it rests and keeps watch, ready to take cover at the first sign of danger.

At the sight of man the little animal rises on its hind legs and has the appearance of an infuriated hunter. It balances firmly and surely on its long feet, the long, curved claws digging into the earth: it glares pugnaciously at the approaching enemy. Dark yellow, sometimes almost ginger, fur covers the round ears; the cruel fangs protrude beneath the whiskered upper lip. It gives out a sharp, barking sound—a sign of annoyance; it is an old hunter disturbed in its own domain.

The "old hunter" is the name the steppe-dwellers have given to this Mongolian marmot.

There is a legend that a very fine marksman once lived on earth. He would travel from one end of the steppe to the other, bragging about how he feared no one, since there was not another huntsman in the world who could shoot as well as he.

Walking through some tall grass one day, he met a frowning horseman and began to brag, as was his custom, not knowing that he was in the presence of a god. To display his skill the huntsman aimed at a swallow on the wing and hit the middle feather of its tail.

The god was angered at this fellow who respected no man, and straightway changed him into a Mongolian marmot who would henceforth hunt only in the summer months, hibernate all the winter, and never drink water. And he commanded that the swallow should for ever have a divided, forked tail, because it had failed to turn aside from the huntsman's arrow.

The legend also has it that when the huntsman-marmot took to the earth, he said:

"The arrow I will take with me. Woe to any who dare to disturb my sleep—the arrow will kill!"

"Perhaps," thought the scientist, "this legend, passed on from one generation to the next, was an expression of the people's bitter experience, a warning to the Mongols that contact with the marmot frequently led to serious, even mortal sickness."

The bold and cunning rodent in the steppe enjoys the fear and respect of the people. Good hunters only risk killing the animal by shooting it from a distance and then only if the animal rises to its hind legs to meet the danger and thus provides proof that it is not diseased.

But there is another way of hunting the Mongolian marmot. A stick with a strong noose of wire attached to it is driven into the space before the marmot's burrow. If the marmot fails to avoid the snare, it is caught and swings round and round in the noose, trying to throw off the thin wire. Hundreds of thousands of animals get caught in this snare. When the hunter skins the dead animal, he comes into close contact with it.

If the marmot is, in fact, attacked by plague, then it is easy enough to see how the microbe can be transferred from marmots to man.

Zabolotny observed the ways of the marmot in its natural habitat and made a careful note of all the stories the local people had to tell of it.

In September, or mid-October, the animals flock together in groups and go into hiding in deep burrows for the hibernation period. They block up the entrances to their burrows. Usually the marmots remain in their burrows until March. But sometimes the characteristic rustling is heard in the depths of the snowless Mongolian winter, there is a sudden movement of the earth, a small head and ears appear and the animal crawls out. This occurs because disease has affected the animal's lungs, the marmot has wakened and begun to suffocate, so it makes a last desperate effort and finds its way into the open air.

Most frequently, however, plague attacks marmots in the summer-time. Hungry birds then greedily fall upon the dead animals, and after a few minutes nothing remains.

All this considerably complicated Zabolotny's work. It seemed almost impossible to discover the centre of epizootic disease in the steppe, so that he could make a careful study in the laboratory of plague-stricken marmots. The black kites and eagles reigned supreme in the overcast sky of the steppe, ever on the alert for prey.

It seemed an almost hopeless task to outwit the birds and find even a small number of dead plague-stricken marmots with a view to investigating them bacteriologically. Yet it had to be done, no matter how difficult.

Zabolotny travelled the length and breadth of the steppe. The nomad Mongols became accustomed to the indefatigable rider. He would return to the camp half-dead from exhaustion. Even in his sleep he dreamed of exactly identical mounds, of ranges of hills like frozen waves, of little wild animals guarding their underground cities.

Was he on the right road? The animal world of the Mongolian steppe was by no means uniform: there were dozens of species of birds, insects, beasts of prey and rodents.

New facts were entered into the note-book. From time to time there were outbreaks of disease among the steppe nomads. The nomads considered that the outbreaks of disease among the people were connected with the outbreaks of disease among the marmots. They called it *tarbagan* disease. But mere conjecture, no matter how likely to be true, was still not knowledge.

Two doctors, Reshetnikov and Belyavsky, gave a precise description of *tarbagan* disease. It took the form of a high fever, swollen glands and haemoptysis, and it almost always ended in death. The symptoms were strikingly similar to those of plague.

Yet there are all too many diseases which show similar symptoms, but are caused by totally different microbes.

Flames cannot indicate the cause of the fire.

Reshetnikov, who had seen dozens of outbreaks of marmot disease and carefully studied the spread of it throughout the long years of his work, was nevertheless convinced that this mortal disease arose spontaneously during the dry months of summer and autumn, when the grass is scorched and the dry ground covered with cracks.

"It is not some special 'spontaneous epidemic' but plague that man catches from the *tarbagan*," was Zabolotny's thought.

But even then it was only conjecture. Was it possible, on the basis of an unproven hypothesis, to try to build up a battle front against one of the most serious dangers threatening humanity?

Zabolotny had to obtain a live culture of the plague microbe from a dead or dying marmot and see it with his own eyes. That alone would allow him to declare that plague and *tarbagan* disease were one and the same thing, to prove that this was not some new, uninvestigated disease, but plague capable of being passed from rodent to man.

In the evenings after the tour of the steppe Daniel Zabolotny would return to his mobile laboratory. He was often so tired that his hands shook. Sometimes it would have been wiser to postpone further work until the morning, but he was loth to waste even a minute. So he would set to work carefully preparing and investigating the material he had brought back. He had arrived now at the actual repositories of plague, yet he was still unable to solve the riddle. The lens of his microscope would sweep over the slide: here was the tenth, hundredth, perhaps the thousandth failure.

Dawn the next day would find Zabolotny out once more in search of material. How many times had he traversed the endless desert steppe and examined marmot burrows in search of dead or dying rodents! On one occasion in a little nomad settlement he came across a disease, all the symptoms of which resembled plague. He vaccinated the patient with a serum and, as soon as he was sure the condition had improved, took a swab for examination under the microscope. While working on material from a plague bubo, Zabolotny pricked himself sharply with the needle of the syringe. A drop of blood stood out on his skin.

The needle had penetrated deeply; possibly the blood stream had already picked up the invading microbes.

Thus an improvident experiment began from self-infection with plague.

"Experiment!" the word flashed through the scientist's mind and probably reassured him. He repeated the word several times in an undertone. What great strength there is in words and ideas to which one is accustomed! The fear he had momentarily felt did not leave him but withdrew into the subconscious.

Zabolotny injected 60 c.c. of anti-plague serum. There was then nothing left to do but wait and observe.

When night came he forced himself to sleep. An hour later he woke up. The microscope and test-tubes containing nutritive media stood in their usual places. Could he be seeing them for the last time?

He went to the table to write a farewell letter. He sat there motionless for a moment, leaning over the sheet of paper and reading and re-reading the first word scribbled mechanically in pencil. Then he tore up the sheet of paper, his premature capitulation to death; he derived physical pleasure from doing so.

It was good that no one had been with him at that hour.

The customary reassuring silence reigned in the laboratory. Zabolotny rose and neatly gathered up the scraps of paper.

Was he reassured? It was, of course, a terrible thought that he might die right there, at the height of his work. And yet he felt no fear, he simply could not believe the accidental experiment would end fatally. It had always seemed to him that if disease triumphs over life then it is the weak conquering the strong. Sometimes it did happen, but it should not be so.

This had been an accidental experiment to which no preliminary thought had been given, yet it completed a great and important stage of the work. The scientist had been given an opportunity of following the whole course of the disease from the moment of infection, and so appraising with accuracy the reliability of the existing methods of treating bubonic plague.

Towards dawn Zabolotny fell asleep. He woke with a very bad headache. He had a fever and he felt weak all over, but his mind was clear throughout. A small fester appeared on the finger of the right hand where the needle had entered; the arm ached. He measured his temperature and found it 101.3; the pulse was 100.

Judging by the symptoms everything was proceeding in the same way as the Khavkin experiment, but the essence of the experiment was quite different: not dead, but living microbes were operating in Zabolotny's blood. The thought crossed his mind that a few years previously there would have been nothing for him to do but wait for death after such an improvident needle-prick. But now, in his case, the glands could not be felt for they had not swollen—an encouraging sign, because the lymphatic system had always been the path taken by plague. But it was still too early to draw the final conclusions: possibly the serum had delayed the development of the disease, had slowed down the process and not checked it.

Some time previously, in Bombay, an experiment had been made for the first time, in which plague infection had been introduced and later treated with serum. But of course the subject had been a monkey and not a man.

Zabolotny well recalled how worried Visokovich, who had headed the Russian medical expedition, had been at the time. Marianna, the experimental monkey, had run away to the darkest corner of the laboratory and refused to take food.

Visokovich remained almost without a break in the laboratory. During the few hours of the experiment. he seemed to grow thin and shrivelled, as though long years had passed.

"I can't understand anyone getting so agitated!" one of the laboratory assistants had whispered to a colleague.

Visokovich overheard, turned round and sharply replied:

"And I can't understand how it's possible to keep calm when an experiment is in progress upon which, in the final count, your lives also depend, even if you do not care about the fate of multitudes of people you do not know! You are not being calm, you are just indifferent."

Gradually but very slowly Marianna recovered. It was a joy to see how the animal's lustreless eyes, veiled with a dull film, came to life and began to shine again.

All these years later Daniel Zabolotny recalled the experiment with which his own fate was now so closely linked. He recalled every detail, every minute, all the thoughts and feelings he had experienced at that time.

Actually the same experiment was now still in progress. What had been tested and confirmed on monkeys was now being tried out on man. This was the basic idea and meaning of what was now taking place. Not only the life of the scientist, but the fate of the ideas to which his life was devoted, was in the balance.

By evening it was clear that the effect of the serum was excellent.

Having recovered, Zabolotny immediately returned to the "main force" of the expedition, which then continued its journey to the east.

From Peking, they turned northwards. After twelve days on the caravan route they reached the Weichang forest. It is here that the Mongolian Plateau drops down in rocky mountain waves. Elks, wild goats and pheasants live in the Weichang forest. In spring and summer the meadows are carpeted with a luxuriant growth of almost alpine vegetation. Weichang was always the favourite hunting ground of the Chinese emperors.

But life was not easy for the inhabitants of those parts. Early in the autumn piercing winds began to howl down the gorges, destroying harvests and spoiling ripening fruits. Ten to fifteen people sheltered in each clay hovel with paper stuck over the windows. From time to time there were outbreaks of disease. The people called it by many names: *wen-i*, *wen-chi*, *wen-tsai*, *hei-wen*; but it was one and the same disease caused by one and the same microbe.

When he returned from his expeditions in Mongolia and China, Zabolotny summed up the first stage of his work. It was now proved by bacteriological experiment that dozens of plague-like diseases—*wen-i, wen-tsai, hei-wen, mahamari* and *lobunga*—are caused by the plague microbe; therefore science had before it only one trend instead of dozens, and on this one trend it could concentrate all its forces. Man had made for himself the first, perhaps not fully perfect, weapon against the plague microbe: Khavkin's vaccine which reduced the possibility of infection, and the anti-plague serum. This by no means meant that the problem was fully solved, but it did rid mankind of the earlier feeling of helplessness. The plague front now lay open along its whole enormous length.

Besides this geography of the disease, there was as yet only a conjecture as to how the earth preserved the plague microbes and plague infection; through what channels the earth passed them on to humanity. This conjecture at least determined the main direction of the investigations, but it had to be converted into precise knowledge.

AT HOME

Now that all this has receded into the past, it is possible to picture to oneself the whole course of the work, from Vetlyanka and Bombay to the time when Daniel

Zabolotny and other scientists after him put forward the supposition that steppe rodents are the carriers of plague from one epidemic to another. If only the officials in the government offices of the Russian Empire and other countries had listened to a brilliant Russian scientist, subsequent epidemics might have been averted and large numbers of lives saved.

But the work had to be done almost single-handed.

Sometimes, every few years, Zabolotny allowed himself to lay aside his work and go home to Podolsk province. There, as his eyes took in the white clay cottages almost drowned in blossoming orchards, and as he felt the warm wind so unlike the cruel, burning atmosphere of the Mongolian steppes or the Khingan mountains, Zabolotny realized that he had been very homesick and the thought crossed his mind that it would be good to stay at home to the end of his days! Such a longing and tenderness filled him that he would almost run without stopping from Krizhopol station to Chebotaryovka and the old familiar cottage surrounded with apple- and cherry-trees.

As the years went by the cottage seemed to grow smaller, to sink deeper into the ground. But the walls were always white and unblemished, with just a tinge of palest blue, as though they had been dipped in the silvery light of a full moon. Near the cottage was a pond, and the orchard stretched from its bank up the hill-side to the cottage. In the orchard were apple- and cherry-trees and, among the older trees—"Daniel's gifts," as Zabolotny's mother called them. They were a desert milk vetch with yellow blossoms and feathery leaves, a dwarf silver fir from Trans-Baikal, and a squat Mongolian elm. Zabolotny had found a young elm dragged up by the wind in the Gobi Desert during a sandstorm, when almost every living thing was suffocating in the hot, sandy air and only the elms, their darkened crowns bent close to the ground, held their own against the scorching wind.

It was cool in the cottage with the shafts of light filtering through the closed shutters. On first entering, these bright streaks of light seemed to make the darkness still denser, but the eyes adapted themselves and from out of the gloom emerged the oven, the table and the big chest covered with bright material, together with a crowd of memories.

On the table, lying in perfect order as though he had handled them only the previous day, lay the sheets of his herbarium, collections of birds' eggs, found with such labour in the steppe and among the reeds, and his books. Zabolotny recalled parting with these treasures after his father's death, when at the age of twelve he had been taken by his uncle, Makar Saulyak, to the town to attend school. It had been the boy's first separation from home and his first journey.

To the boy Makar Saulyak had seemed stern and cold. Only later, when he was a student at the Richelieu Gymnasium in Odessa, did Zabolotny come to know and love the man who, a son of the people, had been able by tremendous effort to obtain a higher education and become a teacher and agronomist; the man who had modelled his life on Chernyshevsky's teaching: "Not serving pure science but the motherland."

While at the gymnasium, Daniel Zabolotny rarely met Makar Saulyak, but when he did Saulyak mostly questioned his nephew, scanning his face and listening attentively to his replies. The day came, however, when after a long silence he said:

"You're a grown lad now, Daniel, so we can talk about real people."

When Makar Saulyak spoke of a real person he meant a great deal. In this case he was referring to Taras Shevchenko whom he loved both for his poetry and for the uncompromising stand he adopted throughout his life; and to Chernyshevsky, "the greatest man on earth," as Makar Saulyak would say.

Saulyak supplied Zabolotny with thick volumes of *Sovremennik** for 1856 and other years, books by Belinsky and Pisarev and research papers by Darwin and Chernyshevsky. At first, the ideas Zabolotny gathered from these books remained separate in his mind from the knowledge he acquired in the gymnasium, but later they came increasingly into conflict with it. Zabolotny felt exactly like someone who has been confined to a stuffy little room for many long years and suddenly finds himself on the sea-shore or in the steppe, where the blue of the sky is at first almost blinding, the fresh air and wind are intoxicating and the broad, open spaces all round, and the numerous roads before him quell all feeling and keep him standing motionless and silent before the surrounding vastnesses.

On Sundays the lad left the town with his books tucked under his jacket and went to the estuary where he could read unhindered in peace and quiet. On one occasion he copied from Pisarev's critical articles "The Realists" some words which seemed to him to be the closest expression of what he himself had been thinking during the past months. "All his work tends towards one single goal," wrote Pisarev of Rakhmetov,** "to diminish the sum total of human sufferings and increase the sum total of human happiness."

When Zabolotny read these words to Makar Saulyak, he was silent for a while as he shook his head, then said in his usual leisurely fashion:

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* *Sovremennik*—a social, political and literary magazine founded by A. S. Pushkin in 1836. N. G. Chernyshevsky contributed to it. In 1866 the magazine was banned by the tsarist government.—*Ed.*

** Rakhmetov—hero of N. G. Chernyshevsky's novel *"What's to Be Done?"—Ed.*

"But I don't think that's what is most important in Rakhmetov and the man who created him. To diminish the sum total of human sufferings is a long-term undertaking; one has first to re-distribute sorrow and happiness. Your father was one of landlord Berezovsky's serfs and he died before he ever saw happiness. My brother was tortured in prison and died of consumption—he never could get enough fresh air, and yet see how much of it there is!"

* * *

Once, while Zabolotny was lying with his book on the grass near the estuary, a shadow fell over the pages and a figure bent over and placed a thin hand, with finger-joints deformed by gout, on the book. The youth looked up and saw Karl Gabbe, the gymnasium inspector.

The following day after lessons Daniel Zabolotny was summoned to the gymnasium headmaster. As he reached the study door, Zabolotny heard the sharp metallic voice of the inspector:

"If the youth from the ranks of the feudal serfs is permitted to rub shoulders with the youth of noble birth, what is one to expect?"

There was a brief pause, then the metallic voice concluded with conviction:

"Rebellion! Nothing but rebellion!"

When Zabolotny entered the study the inspector picked up from the table the volume of *Sovremennik* he had confiscated near the estuary, and read the words Zabolotny had underlined.

"Never have social morals reached such a high level as in our noble day—noble and splendid, despite all the remnants of age-old corruption, because it is harnessing all its strength to wash and cleanse itself from inherited sins."

The inspector tossed the book on to the desk and continued speaking in the same breath, his voice rising with each additional word:

"You underlined that! You did it, don't deny it, evasion will not help in the slightest. How do you suggest we should interpret the expression: 'inherited sins' or 'age-old corruption'? Be so good as to reply!"

The headmaster sat almost motionless at the desk, only nodding his head to indicate he fully endorsed the inspector's words.

In those few seconds Zabolotny was mostly concerned with trying not to get worked up or, at any rate, not to show this miserable, irate creature that he was worked up. "Suppose they do throw me out of the gymnasium, well, let them!" He stood there, drawn up to his full height, his gymnasium uniform buttoned neatly to the chin; his tousled, reddish hair fell on his forehead, the blue eyes that brightened his whole face, looked straight over the head of the inspector towards the excellently polished top-boots in the huge full-length portrait of Alexander II.

To control his feelings, Zabolotny tried to speak after the fashion of Makar Saulyak; he first thought out what he wanted to say and then slowly said aloud the words he had chosen.

"Are not our times noble and splendid and is it not true that social morality has reached a high level, as the article suggests?"

Karl Gabbe stood there adopting the same pose as Alexander II, hand tucked into the front of his uniform. His boots were polished with precisely the same care as the imperial top-boots, and it seemed that the "tsar-liberator" in the portrait hanging in shadow was simply the shade of this nobleman by birth from the Baltic Germans, inspector of the Richelieu Gymnasium, who every year on February 19 wore mourning in memory of 1861.

"And do you know who wrote this article?" the inspector demanded.

"I do. Nikolai Gavrilovich Chernyshevsky."

"And are you aware that Chernyshevsky, the state criminal you have just named, is a rebel? That he was publicly brought out for execution on Mytnin Square in St. Petersburg and condemned to penal servitude and exile for life to Siberia, for plotting to overthrow the existing regime? Are you aware of this?"

Zabolotny did not reply.

"And is not reading the work of a conspirator just as much an attempt to overthrow the existing order?"

Zabolotny stepped forward, picked up the volume of *Sovremennik* the inspector had thrown down, opened it at the back page, which bore the signature of the censor, and handed it back to the inspector.

"Passed for publication," read the inspector in an undertone.

"I thought that if the censor had passed it..." said Zabolotny firmly, but failed to finish the sentence.

"Silence!" blared Gabbe. "Get out of the room and remember you won't get off so easily next time!"

Daniel Zabolotny frequently returned to Chernyshevsky's thoughts on the noble and splendid times, both when conversing with Makar Saulyak during his student years and later, when he had graduated from the gymnasium and chosen his own career as a natural science student or "frog-dissector," as they used to be called.

"The phrase cannot be explained, one just has to feel it," said Makar Saulyak to the young man. "The times are noble and splendid in spite of all the gloom surrounding us, because ever since the years when Belinsky, and particularly Chernyshevsky, began their life work, the Russia of the future: its uncompromising morale, its science which can look far ahead, and the idea of a just social system, have been taking shape even though, so far, only in the most honest and strongest minds. Everything is undergoing revision, is being seen in a new light, and much is being seen for the first time."

Zabolotny listened attentively to the words but by no means understood them at once. His cast of thought, his interests, were those of the natural scientist, and of all the many things of great importance in social thought, that were being accomplished in the country during those years, changes in science and particularly in natural science occupied first place in his mind.

"A science is arising which can look far ahead," said Saulyak. Zabolotny heartily endorsed the truth of his words.

The old science divided the world of nature into hundreds of smaller worlds, into strictly isolated realms of entomology, ornithology, ichthiology and the other branches of natural science. Darwin was able to see the picture of nature as a whole, to see and investigate all the interwoven links without which there is no living nature, no life. In the grand edifice of Darwin's evolutionary doctrine, Zabolotny was primarily attracted by the method of investigation, the ability, without dissecting the living world into hundreds of dead parts, to lay bare the laws of the development of nature. He read through the whole of the "Origin of Species" without a break, then laid the book aside and asked himself which chapter in this brilliant work had made the greatest impression on him. Unhesitatingly he replied: of course, the chapter entitled "Complex Relations of All Animals and Plants to Each Other in the Struggle for Existence." He remembered it very well.

Among other things, Darwin wrote in this chapter that when the owners began to fence off large areas of the valley on the heather moors of Surrey near Farnham, the cattle no longer trampled down the self-sown pines and in a few years the fenced-off areas became completely changed in appearance: the heather was defeated, squeezed out by the young forest; twelve species of new plants, numerous insects which had never before inhabited these parts and, in their wake, new species of insectivorous birds, all made their appearance.

It was only many years later that Zabolotny found himself in Britain: plague had broken out in Glasgow and the Russian scientist was called in to help. He had no time, on that occasion, to go to Surrey and observe the struggle between heather and forest. But he nevertheless remembered all his life Darwin's simple example of the interconnected links existing in living nature. It proved that nature changes, that every natural phenomenon is joined by countless links to the whole living world which surrounds us.

Actually Chernyshevsky (whose works Zabolotny did not as yet fully understand; this understanding was reached only gradually), and Pisarev taught Zabolotny to see in Darwinism something different from, and even more than, what was contained in Darwin's books. The law of the evolution of the animal and vegetable kingdoms gave rise in Zabolotny's mind to the idea that it was not only possible to observe natural evolution, but to change nature. Zabolotny served this great work of changing nature by spending the whole of his life pursuing cholera, diphtheria and syphilis and tracking down, pursuing and destroying plague.

The Novorossiya University in Odessa, where Zabolotny was studying, was flourishing during this period. Only a short time previously Sechenov and Mechnikov had been lecturing there. The university still cherished the traditions of the great Russian natural scientists. Nikolai Umov, the physicist, and Alexander Kovalevsky, the famous embryologist, read lectures there. These professors trained the students to have clear materialist ideas, taught them to seek in the external world for the causes of internal changes, as Sechenov had done when he proved that the external world determines the character of the higher nervous activity of animals and man, as Mechnikov and Pasteur had done when they explained the role of the external world in the origin and spread of diseases.

The higher course students remembered how Mechnikov had once begun one of his lectures with the words:

"There is a disease which causes restriction in man's field of vision. First he sees everything round him, then what might be called blinkers form round his eyes. Finally he can only distinguish one shining point in front of him."

Mechnikov said no more for a moment but narrowly watched his audience. Then he concluded:

"If some scientists voluntarily inflict this disease on themselves, by concerning themselves only with their own narrow speciality, their own subject of observation, one can definitely forecast that they will create nothing truly great or truly important for humanity."

When Zabolotny became a microbiologist and epidemiologist, he never forgot the great scientist's warning.

While a student Zabolotny not only attended lectures and engaged in practical laboratory work, but began to try his hand at independent scientific research. While still a boy at the gymnasium he had observed the peculiar luminescence of the water as he stood on the shore by the Odessa estuaries. There would be a faint shine on the calm surface of the estuaries; a translucent film of light lay on the water, as happens just before dawn or when the moon is full and the moonlight is diffused through a veil of clouds. The theme of Zabolotny's first scientific work sought to explain the cause of this luminescence in the Odessa estuaries.

He would spend the whole day in the Mechnikov laboratory from early morning till late into the night, only tearing himself away from the eye-piece of the microscope when innumerable coloured circles dimmed his eyes and hid the specimen on the slide.

Unicellular plants and the simplest animal life were observed in a drop of water, then stained and fixed. Zabolotny had studied hundreds of specimens showing the life of the microscopic population of the estuaries and proved finally that the luminescence was caused by special infusoria not previously registered in science.

Zabolotny carefully sketched these, "his own," infusoria, looked long and tenderly under the microscope at the cilia, nucleus and nucleolus. For a long time he retained happy memories of his work on the luminescent infusoria of the Odessa estuaries, his first piece of independent research.

* * *

In 1889 Zabolotny was expelled from the university and put under arrest for taking part in student disturbances. In the isolation cell of the Odessa prison when his fate, exile to Siberia or release, was still unknown, Zabolotny thought over his plan of life. This was the time when there were cholera epidemics every year in Asia and Europe. Koch, Wassermann, and Klemperer had been trying to create a sort of working model of the disease by taking a culture of microbes from a cholera patient and using it to infect laboratory animals. They had found it impossible to do; yet if it were only known how to cause cholera experimentally it would be possible deliberately, according to plan, and not blindly, to elaborate methods of struggle against this dangerous disease.

It would, of course, have been interesting to continue studying luminescent infusoria, to ascertain what caused the periodical increase or decrease in the mass of microorganisms in the waters of the estuaries, the peculiar ebb and flow of light. This theme was the beginning of the direct road to a whole chain of investigations showing the role of incalculable masses of bacteria and of the simplest unicellular living organisms, in the cyclic changes of matter. But this, at any rate, was not what was "most important," and Zabolotny was convinced that a man only had the right to devote his efforts to what was vitally necessary for the people.

It was damp in cell No. 35. Little light trickled through the narrow window. Only once in a while, for a few minutes, did the sun stand opposite the window. But the light soon faded. A grey half-light filled the cell. Rats began to scratch about underground. Sometimes the boldest would noiselessly run to the middle of the cell and stare inquisitively at the prisoner. Zabolotny called it his "little neighbour" and the rat would run a little closer. But the dampness of the cell made the prisoner cough painfully and the rat would take fright and vanish.

The coughing grew worse. At night Zabolotny tossed about in a fever and woke up soaked in sweat and completely exhausted. The prison doctor was a man whose attitude to everything on earth was one of indifference; he it was who informed the prison authorities that the student (he did not use Zabolotny's name) would certainly die in prison and that he would hardly live long out of it either. Only when this warning had been given was the case of the prisoner in cell No. 35 brought out into the light of day.

A search of Zabolotny's rooms had produced nothing; there was no evidence except for the faded sheet containing the information written long ago by Karl Gabbe, the gymnasium inspector. All that was known was that Daniel Zabolotny had taken part in student disturbances and that, according to the information of police agents, the student was very much liked by his comrades and allowed himself to make "bold and outrageous speeches" at student meetings; the police agents provided extremely vague information as to what precisely was said in these "bold and outrageous speeches." In a word, no evidence of any worth for use at a trial was discovered while, on the other hand, here was the man dangerously ill and he might even die in prison. There was already sufficient unrest in the town; it was not hard to imagine the trouble there would be if the prisoner were to die.

Before finally deciding the question of the prisoner's fate, the prison doctor was called to the secret police administration.

"So you say Zabolotny's health is, so to speak, not quite. . ." It was well known in the town that the administration chief was what might be called a lenient man, a man who could not bear rough speaking and who, as far as possible, avoided curt, definite phrases. ". . . not quite as it should be," he concluded, smiling because he had found the right words.

"Couldn't be worse," replied the doctor firmly. "The illness is becoming grave and there is also extreme weakness. In fact, you can only rely on God in such cases."

"But if Zabolotny is released?" asked the chief.

"Release is an excellent medicine, but it should have been given to the student much earlier."

A few days after this conversation Zabolotny was released from prison. He was told in the university that there was not the slightest hope of his being reinstated in the coming months. But friends of Mechnikov, Bardakh and Gamaleya gave Zabolotny a friendly welcome to the Mechnikov laboratory.

To the leaders of the laboratory Zabolotny outlined in detail the plans he had finally decided on during his illness. First of all, he explained, an animal had to be found that would be susceptible to experimental cholera. Could they, perhaps, work with *Spermophilus guttatus,* the marmot? It is easy to infect the marmot with fowl cholera and tuberculosis; presumably it would also be sufficiently susceptible to cholera vibriones.

As Gamaleya listened he closely scanned the young man's drawn face. The eyes were sunken, but they shone from the sockets like lights from a tunnel.

"It seems to me you are yourself something in the nature of a 'working model of disease,' " said Gamaleya. "You shouldn't be working, but. . ."

Zabolotny had quite expected and feared that objections would be raised. He felt, at the back of his mind, that if he once took to his bed, if he once let the disease overpower him, it would be very hard indeed to return to a full and active life, in fact he might never do so.

"You should take a trip to Chebotaryovka," Gamaleya persuaded him. "I give you my word that the *Spermophilus guttatus* will wait for you."

"No," Zabolotny interjected. "Even from the viewpoint of my health, the most important thing for me is to forget everything that has just taken place."

"Even your illness?"

"That, first and foremost. I have to convince myself that I still have enough strength."

Gamaleya thought it over and gave permission for the experiment to begin. Zabolotny had tried several different ways of infecting laboratory animals and finally decided to use that which was closest to the natural way in which the microbe enters the organism from the outside world. Oats were moistened with a living culture of cholera vibriones and the infected food was given to the marmots. The first signs of the disease appeared after a few hours, followed by the classic picture of real cholera. Hitherto it had only been possible to observe cholera epidemics in overpopulated towns and there had been no exact knowledge as to the causes of the epidemic. The experimenting scientist was now forcing cholera to attack the cells of laboratory animals.

The scientist could reproduce the disease; but he had yet to find out how to be equally sure about checking it.

Zabolotny worked hard, yet he rarely felt tired; his health was better than before and everyone round him noticed that he had grown strong and was well on the way to recovery.

After a great deal of hesitation the university authorities finally allowed Zabolotny to finish his course of study. But he still did not, for a moment, interrupt his work at the Mechnikov laboratory; the only change was that he worked there later in the evening. In his search for ways to immunize laboratory animals, Zabolotny took as his point of departure the idea put forward by Danilo Samoilovich, his great fellow-countryman and namesake. The introduction of a weak toxin enables the organism to resist the action of a strong poison. The scientist obtained his weak toxin by killing the culture of cholera vibriones.

He then had a new idea. The cholera vibriones entered through the mouth, together with food. The road of infection was perfectly clear. An attempt must be made, first of all, to bar this road, to create local immunity, to arrange things so that at the very beginning of the road the cholera vibrio would encounter prepared resistances and be destroyed.

Zabolotny's idea was to produce immunization through the mouth, *per os*, to use the Latin name later given to this brilliant method, conceived in the Ukraine, of preventing disease.

In the beginning marmots were again used for immunization as being most susceptible to cholera. Gamaleya could see from Zabolotny's shining eyes that the young scientist's plans went considerably further than the matter of saving the lives of a few marmots. Because he was disturbed, he decided to speak seriously to Zabolotny.

"You must postpone this plan of yours. You have only just escaped death, in fact I am not so sure you have finally escaped it, yet here you are tempting providence. Don't forget that it's not so easy to escape death, Daniel Kirillovich."

"I've made no plans," replied Zabolotny stubbornly with a shake of the head.

"A man only has eyes like yours when he is either in love or preparing to take a big step in science.... Or, to be exact, when the two things coincide."

Zabolotny's silence confirmed the diagnosis.

"Then all that remains is for me to wish you and Lyudmila true and lasting happiness. And as for the second question, I think you are justified in making the experiment on yourself, but you can only start it when you've planned it down to the last detail. Begin the experiment only when you have convinced yourself, and can sufficiently convincingly prove to those round you, that your health was normal before the beginning of the experiment, that you were not already infected with a host of other harmful microbes. Wait until you are sure of this, otherwise nothing will come of your experiment."

"All right, I'll think it over," replied Zabolotny as he took his leave.

"Oh, and just a minute, Daniel Kirillovich," said Gamaleya, detaining him.

"Here's an interesting document I received recently from North America. I've translated parts of it. I think you'll find them interesting."

Gamaleya offered a sheet of lined letter-paper to Zabolotny.

The page was headed: "Correspondence between General Amherst, Governor of Nova Scotia and Colonel Bouquet."

Extract from General Amherst's letter: Can one not try to spread smallpox among the insurgent Indian tribes? Every means must be used to suppress them.

Extract from Colonel Bouquet's letter: I will try to spread smallpox by distributing blankets; we will find some means of getting them to them.

Extract from General Amherst's letter: That's good. Smallpox must be spread in that way and all other means used to wipe out this repulsive race.

After twice reading the paper Zabolotny looked up with eyes full of dismay and astonishment.

"Whatever's this? It can't be true!" he said.

"You see, the whole character of our science is changing," said Gamaleya. "The existence of these Generals Amhersts and Colonels Bouquets makes it incumbent upon us to create means of defence as quickly as possible. If the general likes smallpox today, he may demand the use of cholera and plague tomorrow. This sort of thing seems inconceivable until one reads this interesting correspondence. After he has destroyed one 'repulsive race,' as he puts it, the general may tomorrow consider the expediency of extending the experiment. There is only one way of fighting against Amherst and Bouquet—man must become stronger than death. If this demands that we make experiments on ourselves, well, in that case the scientist is not merely permitted to experiment, he simply must experiment. Only I make one essential reservation: the experiment must confirm the idea, not compromise it."

* * *

Zabolotny continued experimenting with animals and waiting patiently for the day when he would be able to test the efficacy of the new immunizing method on himself, and so confirm his idea. By this time he had graduated from the natural science faculty in Odessa and moved to Kiev to take medical training. His experimental animals went with him from the Mechnikov laboratory to Professor Podvisotsky's laboratory in Kiev.

During recent months his health had considerably improved: his organism was not infected with "a host of other microbes"; this meant the experiment need be postponed no longer. Savchenko, one of his Kiev university colleagues, decided to join in the experiment.

"If the experiment is only made on one person, it will convince nobody," said Savchenko.

Zabolotny agreed with his friend's arguments.

The two scientists proceeded to inoculate themselves with dead vibrio and, after waiting for the necessary time to elapse, drank off the suspension of living cholera microbes, the deadly power of which they had already tested in dozens of experiments on rabbits and guinea pigs.

They clinked glasses and drank the liquid off as they might have drunk wine.

"A toast to life! What d'you say, old chap?" said Zabolotny, smiling.

Later that evening found them sitting at the window of the isolation room at the laboratory.

"Aren't you a bit scared?" asked Savchenko.

"We'll come through all right," replied Zabolotny, after searching a moment for the right words. "You know, I think it is wrong in general and even scientifically degrading to think that when scientists experiment on themselves they are deliberately courting death, preparing themselves for death. I am convinced that every doctor, when he starts an experiment, has profound faith in his own hypothesis, in the efficacy of the immunity. He believes it with all his heart. A mistake can happen, of course, but it should not. I know that everything will turn out satisfactorily."

Rabbits that had been given the same culture of cholera vibrio died within eighteen hours, yet Zabolotny and Savchenko showed no signs of a rise in temperature: the immunity brought about by the injection of dead vibrio had worked!

...The beginning of the journey. The memory of years of difficulties and pleasures filled the mind. Laboratory experiments and then testing the results obtained, using these results when on expeditions, in epidemics, in ordinary medical practice. The cholera epidemic in Odessa, the return to Podolsk, his native province, where diphtheria stalked the villages and towns and mowed down thousands of infant lives. And before applying the only means of defence, the new, only recently discovered antidiphtheria serum, it had to be tested, and this meant infecting himself (there had been no time for long hours of thought and experiments on animals). Then the expedition to India, where the idea was born of the possibility of complete victory over plague and then, how the realization of this idea had become the main purpose of his life.

... It was already dark in the cottage. Makar Saulyak, also on a visit to Chebotaryovka, broke into his reflections.

"Well, young man, and what about taking a look at the orchard?" he said. (No doubt to Saulyak, Zabolotny would always be a young man.)

They took spades and set out for the orchard. It was a pity they would have to stop working soon, when they were called in to dinner.

During the evening his mother tentatively asked, as though it was really of little account and she was merely making conversation:

"Are you staying long?"

Zabolotny replied that he would be staying for a month, or perhaps two.

"I've got to rest, and rest properly!" he added, as though to convince himself.

He would stay for a week, or perhaps two. Then he would lie awake at night, seeing in imagination the nomad settlements, the overcrowded hospitals.... He would become disturbed beyond control and would almost pack his things and be on the road. Every person, every day counted! For all he knew, while he was idling there, an epidemic might have broken out again near the Russian frontiers, in Tibet or India, in Arabia or China.

And so the train took him northwards again, from Podolsk to St. Petersburg. And it was high time, too: events were about to take place which required the assistance of all the best forces in Russian science.

IN SEARCH OF THE NON-EXISTENT

Plague broke out in Odessa in the beginning of the twentieth century. The group of doctors defending the town was led by Zabolotny's friend and teacher, Nikolai Gamaleya. By this time Gamaleya's name was linked with brilliant achievements in science. He had joined in the victorious struggle against one of the most dangerous diseases and against its allies, reactionary scientists in America, France, Austria, Portugal and other countries.

It would be as well to recall how this came about.

Louis Pasteur was working on his method of preventive injections against rabies. Never had he been pressing forward so rapidly. In those days, anyone who was bitten by a mad dog or wolf was doomed, and no power on earth could save him. Here, indeed, was such a wonderful opportunity of driving death from its age-old haunts!

One experiment led to another. They all confirmed the scientist's findings. It was apparently time to pass from the countless eminently successful experiments on animals to the work of saving the lives of the doomed.

"There is no need to hurry, Professor." As always, Dr. Roux, who had a somewhat dry and restrained manner, spoke calmly without raising his voice.

"But the problem is solved!" objected Pasteur.

"Even if it is ninety-nine per cent solved, there still remains the one per cent. What would this one per cent show? Would it perhaps reveal mistakes? Science is patient, and surely that is its chief strength."

"It is you who are patient, not science. You should realize that tomorrow you cannot save the people who die today!"

Contrary to the advice of his pupils, Pasteur began to inoculate people.

The new method of treatment was successful.

And yet, with all the dozens of cases of complete recovery, there were still a few cases where the patient died, in spite of the inoculation. Pasteur's enemies pounced on these failures.

"You assert that the patient dies *in spite of* the inoculation. Try to prove that it is not *because of it*. Your inoculations do not hinder the disease, but help it!"

Now Pasteur could indeed recall the calm, carefully-weighed words of Dr. Roux, who was one of his favourite pupils. "You'll live to repent your haste."

But Pasteur was unwilling to repent. These were, perhaps, the most difficult, but at the same time the happiest days of his life. He knew that, without his treatment, the people who daily came from near or far, from all corners of the world, to the laboratory on the rue de Ulm in Paris, were doomed to death.

He was unwilling to retreat. And the people who hated science prepared for battle. Sometimes in the arid steppes bitter-salt waters rise from the lower strata of the earth by capillary action and make their way to the roots of trees and ruin the fields: then only dull silvery patches of salt-marsh are seen on the black, dead expanse. So it was here that forces hostile to progressive science rose up from monastery cells, laboratories, from the universities of Austria, France and other countries which had age-old ties with the Roman Catholic Church.

Professor Peter was married to the sister of Pasteur's wife. He was Pasteur's relative and his greatest enemy. Could he forgive nature for so unfairly distributing her gifts between them, could he miss a single opportunity for revenge at this "unfairness"?!

Not everyone knew that Peter was Louis Pasteur's bitterest enemy. But the instigators of the plot against the prominent scientist knew perfectly well that if a relative struck the blow everything would appear far more convincing to society.

Professor Peter levelled his accusation. He juggled with figures to make white into black—his professional colleagues would forgive him: the press, too, was on his side.

He was obviously not alone. Visitors came to Pasteur from abroad. Among them was Professor Frisch, a well-known representative of the Viennese medical school.

Professor Frisch walked through the laboratory, taking stock of everything, asking questions and listening attentively to the replies.

Herr Frisch, of course, had only one wish—to learn the method and to perform Pasteur's experiments in his own country. He was already certain of success, but it would be wiser to verify all the points and to see with his own eyes. Wasn't that so?

On the heels of Frisch came Professor Spitzka from America, Abreo the silent Portuguese, and de Renzi and Amoroso from Italy.

Shortly afterwards, articles written by Pasteur's visitors began to appear in the scientific press. The Viennese, American, Portuguese and Italian schools of medicine had made common cause with Pasteur's enemies. The extremely ponderous, learned articles aroused doubt in the readers' minds: what were these people actually defending—mankind from disease or disease from mankind?

The world of darkness supported Professor Peter, and Louis Pasteur's enemy felt triumphant.

But his triumph was premature!

Among Pasteur's visitors there was one other foreigner. It was difficult even to regard him as a visitor. He would arrive at the laboratory earlier than anyone else, and the laboratory assistant who felt particularly kindly disposed towards him called him "Monsieur le Matin." He asked few questions, but he verified every word he heard by means of experiment. He was always last to leave the laboratory and would sit up late reading in the library. When he left the reading room, he would tramp the Paris boulevards or take a walk along the Seine embankments, returning home late at night. His concierge thought the young man a night reveller, but he had to admit that he by no means looked like one.

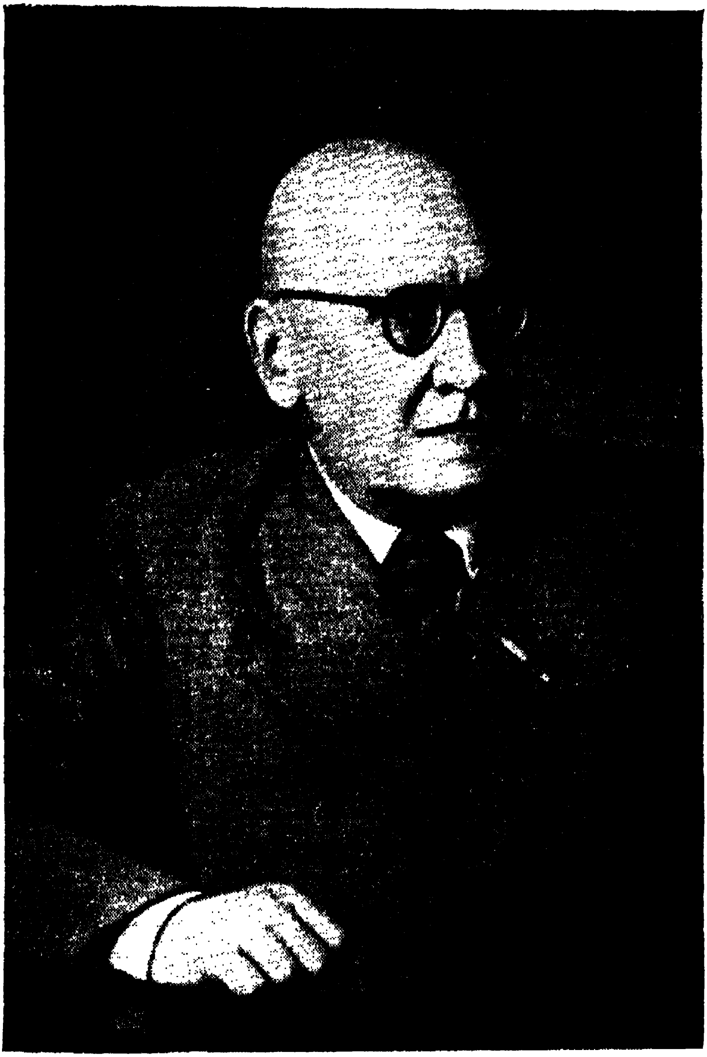
The young man had a strong, determined face and very observant eyes that shone behind his spectacles.

He was Nikolai Gamaleya. The Odessa Association of Physicians had sent him to Paris, on the recommendation of Ilya Mechnikov, and instructed him to study the method of inoculating against rabies and to continue research into it.

That was his occupation in Paris. True, his head was full of numerous plans of his own, but for the time being he had laid them aside. He must do the work entrusted to him: to study and give to the Russian people this splendid weapon against a dangerous disease.

And he was not only to study the new method, he was to improve on it.

He would not only take it back to Russia, but would defend it before the world, in spite of Peter, Frisch, de Renzi, Abreo and Amoroso.



Nikolai Fyodorovich Gamaleya

"I assert that death, in view of the strange symptoms after Pasteur inoculation, is the direct result of inoculation," Peter insisted. "That is my assertion."

There he stood on the rostrum, his head thrown proudly back, listening to the sound of his own voice and mightily pleased with himself; a miserable little creature convinced that he had scored off Pasteur, that Pasteur could never recover from the blow struck at him that day.

In the evening Nikolai Gamaleya was out for a very long time. He strolled along the Seine embankment; a gendarme walking his beat and keeping order followed on his heels. The gendarme was frankly worried: "It appears this uncommunicative street-walker wants to make an end of himself. Let him, but why when I'm on duty and on my beat?"

The gendarme called to the pedestrian. When he turned he touched his cap.

"Should you gaze so long into the water, monsieur? You'll be getting wrong ideas!"

"Don't you think it might give me some good ideas?" Nikolai Gamaleya politely returned.

"Oh, certainly! Then you don't intend jumping it? It is my duty to ask, because every suicide is an official nuisance on earth and a sin for which one has to answer up in heaven."

Did he intend putting an end to himself? Had this gendarme seen into his thoughts, only to interpret them so stupidly and distortedly into his own language? Why, what he had planned could be called anything on earth but suicide. And if he was fated to cause unpleasantness, it was by no means for the gendarme.

Nikolai Gamaleya continued his night stroll.

A foreign land! Here he was alone. There was no one here to give him advice. Yet the decision had to be made that day, without delay. If he was asked his opinion on the point raised by Dr. Roux, the point on which he had disagreed with Louis Pasteur, what would be his reply? If he was asked whether he was sure that the inoculation method now being used was perfectly safe, not merely ninety-nine per cent but a hundred per cent safe, Gamaleya would give the following, unhesitating reply.

"I cannot yet say that I am sure. Inoculation is a great and excellent blessing to mankind. But the method Pasteur uses must and should be improved to make it one hundred per cent safe and effective."

Did this mean one should follow the advice of the cautious and reject inoculation?

Of course not! To do so would mean relinquishing the right to be called a scientist or even a human being. Suppose the method saves dozens of sick people and does not save, or even harms, one person; should hundreds of lives be sacrificed for one? Should we wait?

"Stuff and nonsense!"

He said the words in such a loud voice that the gendarme turned and paused, disturbed again: perhaps Monsieur had changed his mind and would, after all, throw himself into the Seine? There had been so many suicides and somehow these disillusioned ones always chose his beat—the embankment where second-hand books were sold and which was haunted by the shades of the unfortunate lovers and starving creatures these old books described.

The walker moved away from the embankment wall and the gendarme breathed freely again.

Meanwhile Nikolai Gamaleya was engrossed again in his thoughts.

Maybe there was a danger, then all the more reason to prove that the danger was not great.

The Odessa Association of Physicians had sent Gamaleya to study this new achievement in medicine and take it back to Russia. But now his task had become complicated, for first of all the achievement had to be defended; what Pasteur had begun had now to be given strong support and brought to completion. Consequently he had to adapt his behaviour to the altered circumstances. First of all, the "deadly" (as Peter put it), intensive method of inoculations against rabies had to be verified. Should he try it on himself? That was what true scientists always did in cases which science found difficult.

The next morning Nikolai Gamaleya was first, as usual, at the laboratory. He began the experiment he had worked out and decided on the night before. He was the first scientist in the world to test the effect, on the healthy human organism, of Pasteur's inoculations concerning which so many very learned professors, in so many scientific centres, had reached the almost unanimous conclusion: that they were poisonous and dangerous, even deadly.

The experiment turned out successfully. The inoculations caused Nikolai Gamaleya no harm and he was victorious in the battle both against the rabies virus and against the most learned colleagues, since he had struck the first blow against the mortal enemies of progressive science.

But that was not all. He studied all the materials and became convinced that the most learned colleagues had simply not mastered the fundamentals of the science whose fate they were trying to decide. It transpired that extraneous microbes had "accidentally" got into the material which Signori Amoroso and Renzi used for their inoculations; perhaps it was these microbes that had caused the experimental animals to die. And the silent Portuguese, who did not observe the simplest rules of sterilization, performed the operations in such unhygienic conditions that although the animals undoubtedly did die when the inoculating material was injected into them, they nevertheless died just as frequently when no inoculations were made, simply as a result of coming into contact with the Portuguese's lancet.

Thus, Nikolai Gamaleya patiently dealt with one refutation after another and struck a second blow at Western reactionary scientists, the friends of Peter, and Peter himself.

Gamaleya took the new method to Russia, modified and perfected it and, in consequence, the number of deaths after inoculation fell from seven per cent to .61 per cent.

An extremely interesting table of figures was then read out from the chair of the French Academy:

Paris	50	inoculations,	7	deaths
Moscow	16	"	0	"
Samara	14	"	0	"
Odessa	39	"	1	"

And Professor Brouardel, a Frenchman who felt bitterly for his own country, declared:

"See the Odessa laboratory! Russian scientists have more confidence and no failures. Perhaps it is because they are given a free hand and can work in peace without the worry of having to defend themselves daily against cruel attacks."

It sounded strange, of course, in 1887, this talk about freedom in Russia. But it was not a question of the whole of tsarist Russia, but of that young, progressive Russia to which the future belonged, which even in those years of tsarism demonstrated to the world feats of great honour and prowess.

This was the background of Nikolai Gamaleya who, when plague broke out in Odessa in 1901, was put at the head of the work to combat the approaching epidemic.

This time the danger did not appear to be very great: only two cases of plague. By isolating the sick in good time and keeping a close watch on the surrounding population, Gamaleya and the other doctors succeeded in checking the spread of the disease.

Truth to tell, there was even joy in the offices of the Odessa Governor concerning the unexpected occurrence. A brilliant victory won in peacetime and against such a dangerous opponent! This should indeed be reported to St. Petersburg; there the feat would certainly gain recognition.

In anticipation of some reward, a de luxe volume was published, using for the purpose the funds allocated for scientific research into plague. The volume contained the portraits of the rulers of the town, Count Vorontsov and Adjutant-General Sipyagin, and coloured plates of the plague-carrying rats.

The Governor was a little perturbed at the combination of Count and Adjutant-General in full dress uniform and decorations, on the one hand, and then suddenly—rats, on the other. But he was told that the idea was allegorical: victors and vanquished. The words "victors and vanquished" pleased the Governor of Odessa. He marched up and down his spacious study, hands clasped behind his back, repeating the significant words.

Apparently no one for a moment thought of publishing the portraits of the people who had really conquered plague in Odessa, Gamaleya and his assistants.

The money had been spent, yet it was needed now more than ever before. When Gamaleya was informed of what the Governor had said, he protested angrily.

"If anyone in this business has been vanquished it is those who died of plague. And there will be still more of them, no matter how much these "victors" in pigskin bindings may want to forget it."

I

Nikolai Gamaleya was no longer approved of in the Governor's office. Plague had been eliminated, there was order in the town, so there was no need to go searching for non-existent infection. An official coined a malicious phrase: "The man in search of the non-existent."

The phrase caught on and was used time and again in Odessa in reference to Gamaleya, in St. Petersburg concerning Zabolotny and in Astrakhan to describe Deminsky.

People in search of the non-existent!

It might have been necessary to discontinue the investigations, but happily Gamaleya had volunteers to assist him; they agreed to work for a nominal fee or, if necessary, gratuitously.

Gamaleya went down to the Odessa dockyards and studied the history of every ship which entered Russian waters before the outbreak of the epidemic. There was the "Maria Theresa" belonging to the "Österreichischer Lloyd" shipping company, which had covered the trip from Alexandria to Constantinople and Odessa. There had

Lorenzetto who had succumbed, had been buried at an Odessa cemetery.

Gamaleya remembered the path Daniel Zabolotny had sketched on the map many years earlier: from the Arabian sea through the narrow disease-infected neck of the Red Sea to Russian waters. Plague's sea route. It had been foretold then, now the forecast had been proved right.

The docks were the gateway through which plague entered. But how did the disease spread farther?

Gamaleya investigated the drains and cesspools, the underground rat-infested drainage system of the town. Hundreds of dead Odessa rats were studied in the laboratories. The "non-existent" became visible. Here and there warning signals threw out their lights: traces of epizootic outbreaks of plague. Vysokovich and Gamaleya then thought of the idea of destroying every single rat. Evolution had wiped from the face of the earth whole species and orders of animals. Why could this not be done deliberately by the will of man and the forces of science?

If rats were carriers of plague microbes, then surely it was possible to find a different variety of microbes, a disease that was only dangerous to rats, and so produce artificial rat plague.

Most interesting plans were about to be carried out. But the Governor's officials lost patience: plague had been wiped out and there was no reason to talk any more about it. There came a stern order for the commission which was engaged in the fight against rats to be dissolved and the funds discontinued. The order established that the plague epidemic had been abolished.

A few months later the disease broke out again. It was successfully quelled, but the fact remained that it still existed.

THE PLAGUE FORT

On a tiny plot of land at the western end of Kotlin Island, near Kronstadt, "Emperor Alexander I" fort was under construction in 1836. Much time was spent on building it, it was abandoned, and then work began on it again.

The fort might bravely have met the attack of an enemy sailing flotilla; its walls would have stood up to red-hot cannon balls. But military technique had developed; powerful ships armed with long-distance guns now took the place of sailing ships and it was clear that the fort was totally useless for the defence of St. Petersburg. The Admiralty relinquished the old fort and a proposal was made to blow it up. Here the plague scientists intervened and requested to be given the fort for scientific work and for the production of anti-plague serums. And indeed it would be cheaper to let the doctors have it than to blow it up.

And so the plague fort was founded off the shores of Kronstadt in the Baltic Sea. Russian plague scientists now had their permanent base.

The square-embrasured towers of the fort, built of squares of granite rock, lowered over the sea. The dark, heavy, brass-bound gates, embellished with lions' heads, were crowned with the double-headed spread eagle, fixed into a deep niche. By the side of the entrance stood a stripped sentry box and a mushroom-like look-out shelter. A small ice-breaker tug lay alongside the mole, the only means of communication with Kronstadt and St. Petersburg.

The guns were taken away from the fort. The first to take up quarters in the huge, empty building which had something of the Roman Coliseum about it, was the "ever-open eye," a gendarme wearing all the medals won for faithful service to the throne.

Before leaving St. Petersburg, the "ever-open eye" had been given his last instructions.

"What is your chief task?" asked the official of the Third Department,* sternly.

"To keep a watch out for infection, Your Excellency!"

As, in the plague fort, the word "infection" might be taken to mean something else, his Excellency stressed the point to make it quite clear.

"What kind of infection, Sizyakov?"

"For students, of course, and for opinions; for what they are thinking about and so on!"

The gendarme moved in to the little room near the gates. He was timid about leaving his quarters and did no more than keep his pale, staring eyes on the small window, looking out for visitors. He considered it horrible in the fort. Somewhere on the other side of the wall the incinerator furnace roared until late in the evening: this was where the animals that died during experiments were burned. In the autumn the ice-breaker tug sailed away to Kotlin Island where it spent the winter, and the gulf became covered with thin, unsafe ice; there was then no way of reaching the mainland. Sometimes in stormy weather the waves would break up the ice and crash at the entrance to the fort. Water would roll over the mole and burst through the ground floor embrasures. Doctors and assistants would rush to save the valuable laboratory animals, while the "ever-open eye," sidling along so as not to knock against anyone (otherwise one might get infected) would clamber up the patterned cast-iron stairway to the flat roof. "Gloomy place," he thought hopelessly, "accursed place; if I don't watch out I'll end my days here."

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* Third Department—tsarist secret police.—*Ed.*

The fort gradually filled with people. The former powder magazine was made the living quarters of the chief administrator. There it was damp, gloomy and cold, because the sun never looked into the small windows which faced the inner stone-paved court-yard. During the winter months the seven-feet-thick granite walls became frozen through and through and fur coats had to be worn indoors. Vladislav Ivanovich Turchinovich-Vyzhnikevich, who was the administration chief, did his best to see the lighter side of everything.

"But it is airy and cool in the summer," he would say to the rare visitors, almost apologetically.

It was the administration chief who kept the huge key of the fort, which was more than a foot long and green with age. The working day began at seven in the morning when the gates were slowly swung open. A wall of silence surrounded everyone who entered. It was all a little like a monastery: vaulted ceilings, silent, moving figures. Actually the fort with its loop-holes converted into windows was reminiscent of some ancient vessel: from the windows in stormy weather one could watch the waves breaking against the walls and one had a sensation of sailing on the high seas.

Inside, the building was divided into two parts. On the right-hand side were the living rooms, studies and a library. The left-hand side was exclusively for experimental work with plague microbes and for making vaccines and serums. The members of the staff were only allowed to enter this part, the "infectious half" as it was called, for the purpose of working in the laboratories, and then only with the special permission of the administration chief. Reindeer, camels and horses, kept for experimental purposes, wandered at will in the confines of the inner court-yard.

Cultures of microbes brought by Russian microbiologists from all parts of the world were grown in special thermostat cupboards. There was the "Bombay" culture from India which Vysokovich had presented to the fort, and the "Glasgow" strain* obtained by Zabolotny in 1900 during the plague epidemic in Scotland.

The cultures were grown on nutritive broth or agar-agar. By means of a platinum loop, which does not oxidize and is easily sterilized, the microbes together with a drop of liquid, were carefully moved to the new vessel containing fresh agar-agar.

The workers at the fort watched over the condition of the cultures—colonies of microbes—as they would the frame of mind of someone seriously ill: for the dead microbe is a vaccine which makes it possible to halt or, at any rate, to abate an epidemic. Without living microbes it is not possible to obtain anti-plague serums.

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* Strain—the term used in microbiology to signify a culture of microbes of one species, called by the same name but differing in origin. Microbes of different strains often differ in their properties and in the virulence of their effect on the organism.

Expeditions would set out from the fort to places where the epidemic was raging. They would take with them mobile laboratories consisting of microscope, platinum loops, test-tubes of nutritive media, sealed zinc boxes of anti-plague serums and vaccines. Many days later somewhere hundreds of kilometres away from any railway, the doctor in his field hospital would look at these valuable stores on which depended the lives of thousands of people round about. Without doubt he would think of St. Petersburg, the white-crested waves of the Baltic, the fort, the library with its hundreds of periodicals, newspapers and scientific off-prints, all meticulously laid out on the tables. Books. . . . Probably these are what one most longs for when out exploring the countryside. When would one see them all again? Or would one ever see them again?

The day of return would arrive. One could almost distinguish the towers of the fort like semi-circles on either side of the building: at a distance they seemed grey and almost transparent. Then the long sea-wall, the loop-holes in the deep embrasures!

This was the only fort in the world, the "shells" from which travelled to other distant continents carrying not destruction and death but deliverance from danger.

The towers would rise higher and higher out of the restless waves of the gulf. What a grand sensation it was when the heavy door swung open at the entrance and for the first time since returning home one walked over the freshly-washed floors, smelling of water and paint. Once there, the slides and plague cultures, or what Vladislav Ivanovich called the "spoils," would be handed in with all the required precautions; one washed and took a rest and then was free to sit at a desk until late into the night, turning over the closely-printed pages of the newspaper *Russian Doctor*, and the shining white pages of the magazine *Archives*, or to argue with one's colleagues, the voice dropped almost to a whisper in order not to disturb the others. On such occasions it sometimes happened that everyone became drawn into the conversation: they would all gather at one table round the explorer who had just returned from an expedition and question him, relate the news, and all in the same low tone of voice, until someone, looking round the room, would remark:

"Why are we all behaving like conspirators? There's no one here for us to disturb!"

"To return here is like coming home," said Zabolotny to Turchinovich-Vyzhnikevich after returning from one of his expeditions. "It's a scientist's paradise!"

Vladislav Ivanovich frowned.

"Well, hardly. It's all far from ideal. Can you believe that this year the allocations have been halved. We should almost discontinue the experiments we've begun, but you know how it is yourself. . . ."

There was an anecdote current in the fort that if God instructed Vyzhnikevich to equip paradise, he would first spend all the money on building an anti-plague institute on a cloud among the stars, and then ask permission to go down to hell, to some plague-spot.

"Yes, it's very far removed from the ideal!"

They were seated in a little room, the walls of which were covered with armour-plating. It was from here that the fort fire-control officer was to have directed the fire. The narrow loop-holes had been bricked in. Photographs in simple frames hung on the walls. There were two photographs side by side: Mechnikov as a youth in his student cap and a more recent photograph of him sent from the Institut Pasteur in Paris.

For several seconds Daniel Kirillovich looked at the photographs without saying anything. How strange it was: so many years separated one photograph from the other. The first was already yellowed with age, the second had only quite recently been taken; yet the face seemed not to have changed. There was something fundamental, something about the corners of the eyes and the keen and exacting expression of the face that had remained unchanged.

To his own surprise, Zabolotny said:

"Such people don't grow old. Apparently it is the common destiny of all who love their work not to grow old, which means that in old age they die young!"

Zabolotny felt embarrassed at his own too flowery words that had burst from him, as it were, accidentally.

"What's this talk about death?" said Vladislav Ivanovich, a little surprised. "In our position death is almost tantamount to desertion, isn't that so? The work of combatting plague epidemics has only just begun, we are on the first rung of the ladder, and it would be hard at present to estimate just how many rungs have to be climbed!"

He quickly changed the conversation.

"We've just begun some interesting experiments, but the results are not definite. Shall we have a look at them?" he said.

They went up the staircase and down a long corridor. Before going into the left-hand, infectious half of the building, they put on rubber boots and special clothing.

No matting or carpets lay on the floors in the left-hand part of the fort, and their footsteps thudded heavily. The doors fastened automatically behind them. The bare walls were white and oil-painted. Everything was as clean as in an operating theatre. On a metal, enamel-covered table in the laboratory stood a glass chamber with two apertures. A bent transparent tube was introduced into the first opening; a thickening in the tube contained cotton wool and on the end of it was a rubber syringe. A tiny mask was fitted to the end of the second, exit tube. The scientist performing the experiment gently lifted a guinea pig from a cage in the corner of the laboratory.

"Come now, little thing, don't be flustered!"

The mask from the exit tube was placed over the animal's head and fastened neatly round the neck.

The operation began. A little pressure on the rubber syringe, and air passed along the first tube into the glass chamber. At the bottom of the chamber was viable, dried plague culture. The air entering the chamber caused a miniature whirlwind and, although nothing could be seen, one could well imagine millions of microbes rising into the air, filling the whole free space. The channel through the first tube was blocked with cotton wool, but the microbes freely passed along the second, exit tube. The guinea pig breathed avidly, the thorax rising and falling. The air the animal breathed in contained a stream of microbes which passed over the mucous membranes of the mouth and down the respiratory organs into the guinea pig's lungs.

Would the microbes break through the unstable wall of the mucous membranes and enter the blood?

Zabolotny bent over and carefully read through the notes of previous experiments written in a note-book on the table.

The invisible whirlwind of plague was separated from the scientist by nothing but a thin sheet of glass. Suppose by a careless movement the fragile chamber were broken or, somehow, the tube were not sufficiently firmly driven in or, suppose the wriggling guinea pig were to throw off the inconvenient mask and escape to freedom for less than a second, what would happen?

The microbes would escape into the air and a totally different experiment would be in progress.

Zabolotny turned over the pages of notes.

"The results are extremely indefinite," said Vladislav Ivanovich. "Look at this: experiment No. 1—no infection resulted; then No. 4 ... though it is just possible that in this experiment there was damaged mucous membrane that had been overlooked."

He spoke very softly in order not to hinder the doctor working on the experiment. Zabolotny nodded by way of reply.

This was one of a long series of experiments that would make it possible to determine the methods by which plague caused infection and the susceptibility to the disease of all kinds of animals from the guinea pig, marmot and jerboa to the reindeer and camel.

The conversation was resumed in the corridor.

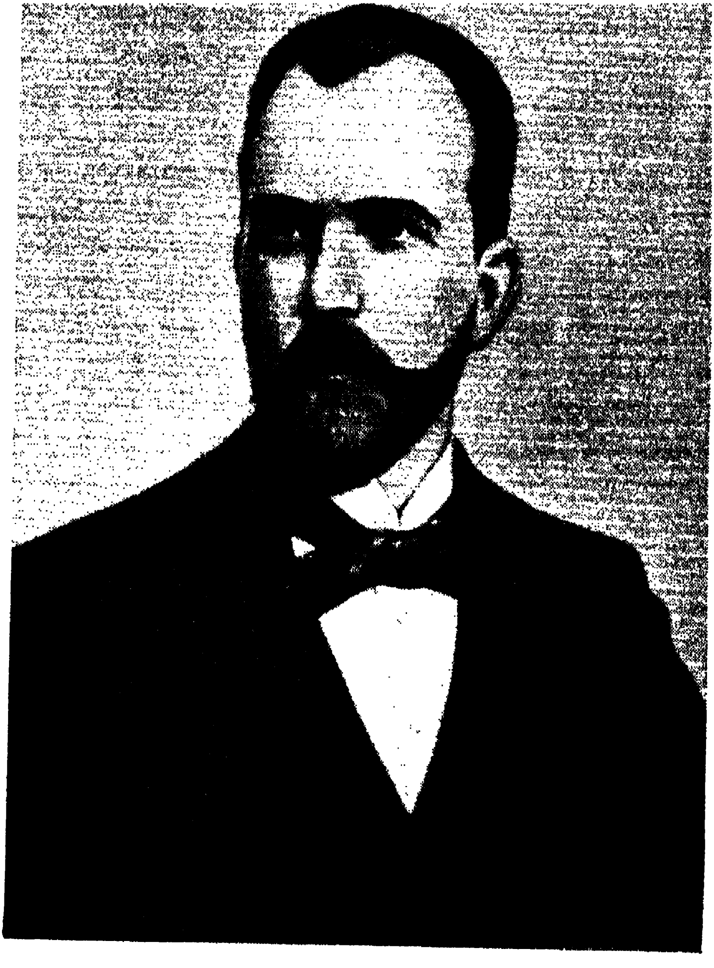
"We need not one but scores of laboratories like this," said Zabolotny. "We need them in Siberia and Astrakhan. And expeditions should be sent there now, during the years when plague is dormant, not when an epidemic has broken out. We have no time to spare, Odessa proved that. We have to reckon in days, not centuries. I don't know how you feel about it, but I'm always in a state of oppressive anticipation of the next great outbreak."

Vyzhnikevich and Zabolotny passed through the barrier separating the laboratories from the rest of the fort and entered the living quarters. One of the domestic staff put glasses of hot, strong tea on the table.

"Just what we wanted," said Zabolotny, warming his hands on the glass. "It's pretty cold today."

The bitter cold of the St. Petersburg winter penetrated the stone walls and filled the room.

Before leaving, Zabolotny exchanged a firm handshake with Vyzhnikevich. Without these colleagues who refused to grow tired, who could see the goal and believed it could be reached, without this plague fort, his work would have been a thousand times more difficult.



Vladislav Ivanovich Turchinovich-Vyzhnikevich

A penetrating wind lashed him as soon as he was outside. He had before him a long and tiring journey: almost a mile on foot to Kronstadt, then about six miles on droshky to Oranienbaum, then another hour's journey by train.

It was already winter again; lately Zabolotny had been acutely aware of how quickly time passed.

St. Petersburg seemed unfriendly. The light from the street-lamps flickering like reflections in rippling water; the huge pile of St. Isaac's Cathedral towering above the square; the Bronze Horseman, a frosty mist enveloping the legs of his steed; gusts of wind intermittently dispelling the mist; in the darkness, the street-lamps sketched the contours of the streets in geometrically perfect outlines.

St. Petersburg! Nowhere else in the world is there a city where one feels so strongly both the force of the elements and the strength of will of the man who has chosen to walk in the teeth of the wind, against the stream, against the hostile forces of nature; a city from which it is good to launch out on great and difficult enterprises.

On his way home Zabolotny called at the Institute of Experimental Medicine to take a look at his laboratory. The microscope in its case stood on the table. The lamp hung low from the ceiling, throwing a perfect circle of light. There was a pile of unread periodicals. Daniel Kirillovich sat down to read for just a moment, but it was far into the night when he put his book aside.

So another year came to an end.

For Zabolotny the new year 1904 began with difficulties and anxieties.

During the afternoon of January 4, a messenger brought a note from the fort, bearing the few words: "Please come at once."

Perhaps some important experiment was finished and there were interesting results; perhaps his advice was needed or he was simply to share in the rejoicing? But why the words "at once"? And why had Schreiber signed the note, and not Vyzhnikevich? Zabolotny knew for certain that Vyzhnikevich was at the fort.

It was a cold day. The wind drove across the ice, sweeping up the snow and whirling it round the fort. A fresh wave of biting snowdust was driven every second from the gulf to the sea-wall and the fort. Extra men were on duty at intervals along the sea-wall.

The fort was situated on Kronstadt territory and was under military authority. The sentry on duty knew Zabolotny by sight, but he nevertheless called the corporal of the guard, who carefully checked Zabolotny's documents. Dr. Schreiber met him at the entrance and together they proceeded to the library.

"Vladislav Ivanovich is seriously ill," Schreiber explained anxiously. "After a trip to St. Petersburg, he arrived back tired, worn out in fact, and during the night. . . "

Without concluding the sentence, he handed Zabolotny a paper with notes on the illness. The temperature was high, almost 104°.

Zabolotny entered the room where Vyzhnikevich was lying. He had been transferred from the ice room of the former powder magazine to the laboratory on the third floor; there it was warmer and the sun occasionally filtered through. Vyzhnikevich raised his heavy eyelids with obvious difficulty.

"You see, I've caught a chill," he said and then repeated, as though asking for confirmation: "I must have caught a chill."

Silently the laboratory assistant shifted the screens, concealing the cupboard of laboratory equipment. Zabolotny closely sounded the sick man. There was a sharply defined focus of inflammation in the right lung.

A few moments later Zabolotny and some of the staff at the fort held a consultation in the next room.

"Between December 28 and New Year's Eve, our friend was engaged on experiments," Schreiber reported. "He infected the lungs of an animal with powdered cultures and was preparing plague toxin by a new method, which involved preliminary freezing of the microbe bodies with liquid air. He attached great practical importance to his work and was hurrying to complete his experiments as soon as possible."

No one had yet used the word "plague," but the consultants regarded the illness as suspicious.

In the evening the patient was examined again. The sound heard at the shoulder blades was muffled; there was the characteristic crepitation.

In view of the disturbing state of affairs, more people arrived from St. Petersburg: Major-General Count Orbeliani and his adjutant. The General was appointed Commandant of the fort for the duration of the quarantine. Once the two officers were installed, the fort became completely isolated from the outer world.

After the consultation Zabolotny was walking along the corridor deep in thought when he suddenly stopped.

He distinctly heard a voice from the other side of the wall.

"If it's plague, Your Excellency, I would blow up the fort, as soon as this quarantine ends. How can we tolerate the existence of such danger, particularly so close to St. Petersburg!"

It was obviously the voice of the adjutant.

Blow up the fort if it's plague! What crass indifference! If there were plague outside the fort, in the big world, would they, then, blow up the world? Blow up the fort, the only base that was combating plague, the only place where anti-plague vaccines and serums were being made for Russia and her neighbouring countries!

The General made some reply but Zabolotny was no longer listening to the rest of the conversation.

Because plague was suspected, Vyzhnikevich was given a subcutaneous injection of 100 c.c. of serum. Every member of the staff who had been in contact with the patient was given a prophylactic, protective injection.

The patient's temperature began to drop. If it was plague, then a decisive struggle between the antibodies in the serum and the microbes was now in progress in the blood vessels, lymphatic vessels and lung tissues; it was the same struggle Zabolotny had once experienced himself. On that occasion life had won the victory completely and conclusively.

Zabolotny believed with all his heart that if only they were not too late it should be the same again.

But an hour later the patient's condition became worse. There was delirium and the patient tossed on the bed. The temperature was 104°, the pulse 80-90, breathing —25 to the minute.

Zabolotny carefully examined the laboratory where Vyzhnikevich had been making his investigations. On the table was a broken agate mortar of the type generally used for grinding microbes and preparing the emulsion of microbe bodies.

That night no one slept at the fort. When the wind dropped, the pacing of the sentry could be clearly heard from the other side of the wall.

On the evening of January 5 the characteristic reddish sputum appeared. Zabolotny carefully prepared the slides. Slowly his fingers turned the fine-adjustment of the microscope. The specimen slipped so sharply into relief that he had to make an effort not to blink and withdraw his eye; there were masses of bipolar rods, the ends clearly stained, lying motionless in the field of vision.

So it was pneumonic plague!

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It was now impossible to discover exactly how plague had escaped during the experiments on New Year's Eve, how the microbes had entered the scientist's lungs.

The following morning the patient was given another 200 c.c. of serum: 100 c.c. subcutaneously and 100 c.c. injected into the right pleural cavity, into the heart of the disease. The temperature curve slid downwards and then remained for a time at one level—equilibrium between the power of the disease and that of the serum. The patient began to gain consciousness.

Zabolotny and the *feldsher*, Poplavsky, were alone with the patient. Poplavsky was an attentive, experienced and steady worker and it was he who had been nursing the patient throughout. Vyzhnikevich opened his eyes and slowly and with difficulty looked around him. He spoke very softly and at first it was difficult to distinguish the separate words.

"The staff must be given protective injections. Has it been done?"

"Yes!" replied Zabolotny.

"My request is that you burn my body when it is over. And tell my colleagues that I am sure they will continue and complete what has been started. For we are only now at . . ." the voice became inaudible and he was unable to finish the sentence.

A third injection of serum brought no change in the condition. At 6 o'clock on the evening of January 7, Vladislav Ivanovich Turchinovich-Vyzhnikevich, chief of the plague fort laboratories, died.

The serum, which was powerless to save the life of one who had been chiefly responsible for its creation, successfully protected all the other workers at the fort. Although during the early days of the illness, when no one had yet suspected the nature of the illness, many doctors and nurses had spoken with Vyzhnikevich and had visited him without wearing masks, not one of them fell ill. *Feldsher* Poplavsky had a high temperature but a few days later he was well again.

The quarantine was lifted one bright day when the sun shone with the promise of spring. Zabolotny walked the streets of St. Petersburg feeling as though he had been absent for several long years and not for just two weeks. He was overcome with weariness and felt oppressed, as though it were he who had undergone a serious illness and his life that was still in the balance. He felt he could hardly find strength enough to get home. His brain seemed veiled in a grey mist through which one thought kept hammering at him, demanding to be remembered: there was no time to be lost, Vyzhnikevich's death was the warning.

TWO VICTORIES

IN MANCHURIA

The history of the 1910 Manchurian epidemic can be reconstructed with the same logical consistency with which meteorologists determine the formations and movements of clouds and the impacts which cause storms.

Year by year the catastrophe came closer. In the years 1909 and 1910 the largest fur-trading firms in Germany and France began to use a new technique to manufacture furs from the pelts of the *tarbagan*, or marmot. The cheap raw material was transformed into beautiful, hard-wearing furs which immediately won for themselves a wide selling market.

The price of the pelts soared at Leipzig fair. The Manchurian hunters began to earn money. British drug traders seized upon these favourable circumstances to raise prices sixfold. The daily dose of opium in the opium dens of Mukden, Harbin and other Manchurian towns began to cost more than a skilled worker's daily wage. Speculators sharply increased the price of rice. To the workers, reduced to extreme poverty and poisoned with narcotics, they said:

"If you want to make money for bread and opium, go to the steppe and try your luck catching *tarbagans*."

In this way the "*tarbagan* rush" began. One after another groups of hunters left the Manchurian towns and villages for the *tarbagan* hunting industry. It was starvation that drove them into the steppe. There were thousands of hunters roaming the uninhabited expanses where previously one would not meet a living soul in a whole day's journey. The spark of plague, which periodically attacked the *tarbagans*, usually flickered out unnoticed in the deserted steppe; but now it caused a conflagration.

The outbreak of disease was not observed in time. Death from poverty and starvation was such a frequent occurrence in this tortured, forsaken country, that a slight increase in the number of victims surprised no one. And so plague was given sufficient time to get a strong foothold.

It was the custom for the hunter to hand over the skins and hurry off to the opium den.

Smoky paper covered the windows of the little *fanza*. Inside, along the walls were low bunks, covered with matting. Here it was always dark, even in the daytime. Light from the lamps hardly penetrated the heavy, bluish smoke which filled the room. The man would be given a pipe that had just fallen from the mouth of some poor devil who had smoked himself senseless and lay sprawled helplessly on a bunk. Among the confusion of smokers lying side by side with glassy, staring eyes, some sleeping, some lost in reverie, no attention was ever paid to a man in his death agony. If the keeper of the *fanza* found a corpse the following morning, he hurled it into Sungari River.

The doss-houses and opium dens were the gates through which this disease, born in the steppe, penetrated into towns and villages. Between June and October 1910 no one noticed the plague gaining a foothold in the densely populated ant-hills known as Manchurian towns.

Only when the death rate reached alarming proportions and at one place, Manchuria station, 390 people died between mid-October and the beginning of November, was it proved that plague was the cause of this catastrophically high death rate and news of the epidemic crossed the country's frontiers.

For Zabolotny, the telegram reporting the calamity that had struck this state on the Russian border was a moral command. Without a moment's delay he set out for the plague spot.

The train raced from West to East. There was enough time on the journey to think of what lay ahead, and there was, indeed, plenty to think about. Zabolotny reconstructed for himself what he called "the formula of the epidemic:" the *tarbagan* industry, the epizootic diseases among rodents which went unobserved, the towns with no doctors.

Stark poverty reigned throughout the world. To break through it, forces considerably stronger than a small group of doctors were required. Poverty among the population and famine paved the way for disease and nullified the efforts of science.

It was sheer torture to think of it. It was like crossing an endless marshy swamp. An ocean of poverty from Jedda, from Bombay, to China!

And why only as far as China? He should at least be honest with himself: as far as Moscow and St. Petersburg.

Before leaving for Manchuria, Zabolotny happened to attend a lecture delivered by Ignatyev, a Moscow paediatrist. He was a small gloomy man and he lectured in a monotonous, almost toneless voice. At first Zabolotny only half-listened; the subject was foreign to him, he knew almost nothing about it. But the long list of figures, read out in the same monotonous voice, attracted his attention in spite of himself. Ignatyev was giving figures for the years 1895 and 1904 of the death rate among infants in their first year, for the police areas of Moscow. In the Second Lefortovo District, 55 per cent of the children born died in their first year; in the Rogozh District—53 per cent.

As the lecturer named the districts, he used a pointer to indicate the places on a map of the city. The pointer described a circle. The death rate that was catastrophic in the Presnya, Serpukhovo and Rogozh districts, fell as it approached the centre of the city. In the Tverskaya and Myasnitskaya police districts, the death rate had fallen from 55 to 9 per cent.

The words of the Carmagnole came to his mind, the song that seemed to have been forgotten during the long years that had passed since his student days:

What do we want for our native land?
Equality for the people.

It would appear that from the moment a man was born in Lefortovo or Rogozh districts, he had only one-sixth of the right to live that was granted to a similar person born in the wealthier districts of Myasnitskaya and Tverskaya.

Of the children, 7.4 per cent died of infectious diseases and 26.9 of inherited weakness or, in other words, poverty.

The pointer slowly continued to describe circles on the map of Moscow.

Could not similar death zones be marked on the map of the world? Had not Zabolotny met them in all his journeyings? Britain and her overseas colonial possessions, London and Bombay, the slums of London and the West End.

Meanwhile the train traversed the countryside.

The sense of open spaces that Zabolotny loved so much could not reassure him this time. The rain that had started when the train left Moscow had dimmed the window-panes. On the Eastern side of the Urals, snow had taken the place of rain. Now the mountains were left behind and the monotonous snowbound Siberian lowlands stretched far into the distance.

The nearer Zabolotny approached the place where he was to work, the more anxious did he feel in his mind. Normally he would never allow such a mood and such a train of anxious thoughts to gain possession of him. He knew, or rather suspected, what was the cause of the epidemic. But how did this knowledge help? In a few years' time, would the epidemic really break out again as surely as one eclipse of the sun follows another?

To tell himself that science can only more or less accurately determine or discover, but cannot change, was to admit that the whole of the life work he had chosen was incorrect, almost useless.

Already somewhere near Omsk, an atmosphere of uncertainty, elusive at first but steadily becoming more definite, had seized the passengers in the train. A gold industrialist from Irkutsk, travelling in the same carriage, again asked him in astonishment:

"You're really going to Harbin? But there's plague there!"

"It is to the epidemic that I'm travelling."

The fellow-traveller involuntarily drew away from him as though Zabolotny's plans alone were sufficient to put him beyond the pale and make him dangerous to those around him.

It had been so on previous journeys, at the fort, and now again on this occasion. In a word, every time difficult and dangerous work lay ahead, Zabolotny sensed the indifference of the philistines and officials, the almost hostile vacuum which formed itself round the small group of Russian doctors who had dedicated their lives to the struggle against infections.

It was easy to live like the adjutant: "If there's plague in the fort, blow up the fort;" If there's plague in Manchuria, blow up Manchuria! The whole world was divided into "I" and the rest. When the rest were dangerous, they had to be isolated or, better still, destroyed. This was the whole philosophy of life of such people.

Incidentally, this senseless hostility of the philistines and officials did not oppress Zabolotny; on the contrary, it somehow reassured him. It seemed to confirm the correctness of the direction he had chosen. "Against the stream but with the people," Makar Saulyak had once said. The wheels of the train knocked out the words:

"What do we want for our native land?"

Zabolotny's thoughts ran on: It would be simply criminal to use the words "inevitable" or "normal" in connection with epidemics. The "inevitable" was caused by poverty. The social multiplied by the biological factor. If we cannot yet destroy social evil, at least we can reduce the biological factor; if it is not possible to dam up the channel along which disease spreads, at least we must make it narrower.

"We are on the first rung," Vyzhnikevich had said not long before his illness. Had much changed since then? While Zabolotny had been searching for the living carriers of plague, scientists had come forward who asserted that it was necessary to proceed along a totally different road.

"*Tarbagans*?" they asked. "Which of our doctors has seen a sick *tarbagan* with his own eyes?"

None!

And why is it that the territory where the *tarbagans* range is tremendous, yet the boundaries of plague do not coincide with it but only form isolated patches on it?

And why, further, does the disease appear in parts of the steppe where there are no *tarbagans* at all, for instance in the Caspian area?

You say that other species of rodents are to be found there, that the path of the disease differs in different geographical zones. But why, then, search for replies to hundreds of questions when a much simpler, and clearer, hypothesis suggests itself? Man is the only carrier of plague infection: the living human being during the epidemic, the human corpse between the epidemics.

The "bridge of death" was the name Zabolotny privately gave to this hypothesis based on the supposition that the bodies of the dead, and the articles plague-sick patients had used, were the chief storehouses of plague infection. Zabolotny knew that this "bridge of death" idea was gaining increasing support.

A special expedition led by Shurupov went out to the sites of recent epidemics and brought back sealed cases containing two hundred samples from the graves of people who, a year previously, had died of plague. Of the two hundred samples, seventeen produced a growth of suspicious, plague-like cultures.

Only seventeen out of two hundred, and only suspicious cultures!

The "bridge of death" was, indeed, built on extremely shaky foundations, and yet many believed in it. The hypothesis had clarity and simplicity on its side.

What could Daniel Zabolotny put forward to counter this hypothesis? Long, indefatigable and unsuccessful searches for the living carriers of the disease to be found in nature? A deep conviction that only after catching and carefully studying these living carriers would it be possible to transfer the battle against plague from the places where it was even now in progress, namely, the hospitals and epidemic outbreaks, out into natural spheres, outside the zone of human life and human society?

It was not enough to believe, there had to be *proofs*! It was many years later that Pavlov said: "No matter how perfect a bird's wing may be, it could never lift the bird to any height without the support of the air. Facts are the air of the scientist."

All Zabolotny needed was the air of facts, so that he could convert his idea into a weapon in the hands of mankind. All those years he had sought honestly, sparing no efforts and risking his life, but he had not found them. This meant he had to search with greater energy still.

In Manchuria not only was he to meet the existing epidemic which was spreading hourly and daily with hurricane speed: from its centre to the west, north-west and the frontiers of Siberia; to the south, south-west and the central regions of China; to the east and the shores of the ocean. He was also to learn about the history of plague, everything which links each new outbreak of disease with the preceding and the subsequent outbreaks.

THE MOSCOW PLAGUE CENTRE

The success of the whole work depended primarily on whether there were enough doctors to combat the disease.

Apparently, the word "plague" which urged thousands and tens of thousands of people to flee in panic from plague-stricken towns, not only repulsed, but attracted. In the usually deserted "Plague Fort," where in quiet years not more than five doctors were at work, dozens of medical students and young epidemiologists went through the special training required for work against plague. Volunteers from St. Petersburg, Moscow and Tomsk travelled towards Manchuria and against the stream of plague-fleeing refugees.

While still at secondary school, Maria Alexandrovna Lebedeva was nicknamed "Swan." She was thin and small and not very good-looking, but she had large grey eyes which she closed when she was thinking, as though the thin, semi-translucent walls of the eyelids must exclude everything to which she could not or would not reconcile herself. The nickname Swan remained with her to the end of her days, perhaps because she always made people feel that she was "here today and gone tomorrow" and that in obedience to the laws of her own special world, she might at any moment spread her wings and fly off into the unknown.

She denied herself essentials, separated from her family and used the money she had saved to continue her studies in Geneva. At the end of her course there, she was offered the opportunity of remaining as a research student, but she preferred to go to the remote regions of Russia, far into the taiga on the East bank of the Yenisei River.

"It will be very hard working there," she was warned, when she arrived at Krasnoyarsk. "A sparse, nomad population, not more than one person to every twenty square miles. The doctor has to undertake everything that comes to hand, from complicated operations to midwifery."

Lebedeva listened attentively, but still insisted on the work. There had been no doctor in the area for two years, ever since Dr. Izorgin, an exiled doctor, had died. If she changed her mind, the surrounding population would have no medical assistance during the coming winter.

Most of all she feared surgical work. She had had not more than two months' practice in a clinic under the supervision of a professor, and this was quite inadequate for independent medical practice.

Lebedeva was immediately put to the test, before she had time to settle in at her new home, which was a log cabin buried almost to the roof in snow. Her body ached from the long journey. She and the *kayur** had

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Kayur—a sledge driver.—*Ed.*

finished digging their way through the snow to the front door and had just lit the stove. Flames licked the bark and encircled the logs with a yellow collar and a second later were penetrating to the heart of the wood. There was a strong smell of tar, and waves of warmth began to fill the room. The fire filled the whole stove. It became so hot that Lebedeva was about to remove her reindeer jerkin and hood, when she suddenly heard a voice, and a moment later the *kayur* appeared bringing with him a local *Evenk*. From the few words exchanged she understood that she must set out immediately.

A few moments later she was ready and hurrying out of the hut. The dog-team set off along an almost invisible track. Lebedeva sometimes ran after the sledge and sometimes threw herself sideways on to it. The snow whirled before her eyes making her feel she was travelling at top speed.

She would have preferred the time to drag, she could then have prepared herself for what was to come.

Suddenly the taiga forest opened out and the track descended sharply to a small, snow-swept river. Lebedeva had scarcely time to hear the ice crack and see the last dogs in the team scratching hard at the ice when, clinging with all her might to the sledge, she was plunged into ice-cold water. Only when she again opened her eyes and saw the fine, driving snow did she realize that the danger had passed. Every stitch of clothing was iced over, and the cold seemed to penetrate to the heart. While she tried to control the shivering, she told herself that she needed every ounce of strength and had no right to be thinking of anything else.

Fortunately the nomad camp was quite near.

Lebedeva entered the tent and with difficulty removed her ice-stiffened, now bell-like reindeer jerkin and hood. She had only to take one look at the ragged wound, where the wild beast had clawed the body; she realized there was no more time to be lost, that it was almost too late already.

While the instruments were being sterilized in the portable sterilizer, she tried to visualize each stage of the operation she had to perform.

Gradually (and this had happened to her many times before), the knowledge that she must do what had to be done and save the life of the patient gave her confidence to cope with the task. Just as iron filings in a magnetic field obediently dispose themselves between the poles, so now all her inner forces fell into position, subordinated to the work which required tremendous exertion and complete assurance on the part of the doctor.

The operation lasted for two hours, but Lebedeva only noticed the time it had taken, when the last stitches had been put in and she could lay aside the surgical needle, relax her muscles and let fall her arms.

For three years, Lebedeva travelled the length and breadth of the area for which she was responsible, fighting trachoma, tuberculosis and many other diseases which were common in those parts. She could not have said whether the death-rate perceptibly decreased during these years of work, but without her and without her medical work, the death rate among the local population would have increased rapidly year by year. That she did know.

As he listened to her talking, Leonid Maximovich Tulyanov, an old doctor from the neighbouring area, whom she met not more than three or four times a year, would say, wearily:

"It only means, my little Swan, prolonging the inevitable process for another decade, that's all. All these complicated operations, resections and injections are just a battle for one-tenth per cent of the death rate. It all amounts to trying, by means of all these things, to overcome the devastating influences of evil Russian capitalism, which reveals its most bestial side in these god-forsaken parts; it means combating alcoholics and syphilitics, it means prolonging the dying-out process, that's all it is."

"And do you know, my dear, how your predecessor, Dr. Izorgin, died?" he added, after a brief silence. "In the first few months he was preparing material for a book on the salubrious nature of the air in these parts; then, later, he found he had galloping consumption. Nowadays the man who dreams of universal justice dies in prison or in exile, while the doctor dies of consumption."

"How would you have it, then?" interrupted Lebedeva. "Would you have us 'sacrificing nothing to anger or love?' You remember the words Alexander Barannikov said when he was taken out for execution by the tsarist court?"

She repeated the lines she had read as a child and remembered all her life.

"Friends! There remains one step to the edge of the grave. With deep faith in my sacred cause, with firm conviction in its early triumph, fully conscious that as far as my feeble strength allowed I have served it, I quit the stage.... Live and triumph! We triumph and die!"

Tulyanov thought for a moment. More than twenty years had passed since the day when a revolutionary, condemned to execution, had said those words. When would it come, this early triumph?

The words "live and triumph!" pronounced with such ardent faith in the ringing tones of a woman's voice still sounded in his ears. The fire in the stove had died down; it was cold in the room and the snow outside was piled half-way up the window-panes. Why did she not notice all this?

"My God, you can't surely believe in what you've been saying about prolonging the agony?" said Lebedeva.

"Don't you feel, don't you see already that the stormy petrel is hovering over Russia? I live because the change will soon come and because we must preserve the vital forces of the people until the day of liberation."

"That is all very well in songs and folk-tales, my dear—the day of liberation," he replied calmly. "I used to believe in the early advent of the realm of justice. Once to believe and once to lose faith—more for the human heart is inconceivable."

When the news arrived of the revolutionary events of 1905 Lebedeva left work and returned to Moscow. She felt the train was taking her straight into the spring.

The spring, however, did not last and the journey was too long.

From Moscow she went to work in Kursk Province. There she was arrested for revolutionary agitation. After serving a term of imprisonment, she decided to take a rest with relatives in Vladivostok, but while travelling to her destination, she learned of plague in Manchuria and changed her route.

Geneva, the taiga, revolutionary work, prison, work in an epidemic—this was the perfectly straight road taken by a woman who lived to bring the future nearer.

The Moscow plague centre in Manchuria consisted of volunteers and was housed on the outskirts of Harbin. The wooden building stood gloomily in the centre of a vast open space. Its walls were blackened with age. It had a high porch with fretted woodwork. In a corner of the yard by the fence there was a heap of frozen corpses under an awning. Day and night the ambulance of the "flying squad" stood on duty at the gates.

There were so many dead bodies, they could not be burned fast enough. They lay frozen and blackened on the ice of the Sungari River, they poked out of ice-holes, they lay untouched in *fanzas* and in some places they were simply covered under heaps of snow.

Even in the presence of most acute danger, in this death-saturated, ice-laden atmosphere, there was no universal co-operation in facing the common enemy. On the contrary, because of the danger, the townspeople were even more sharply divided into two camps.

Zabolotny, Lebedeva and Mamantov, a student from the St. Petersburg Army Medical Academy, Dr. Pallon, sister Snezhkova and all the other medical workers combating plague, sensed this division at once. The barren open space round the Moscow Plague Centre became an invisible barricade separating those who worked on the epidemic from the rest of the town and, perhaps most of all, from the Russian colony of merchants and officials in Harbin.

"What do you think?" asked Lebedeva of her colleagues one evening. "If we were all to die here, what would be the attitude there in Harbin?"

Her colleagues did not reply. After thinking for a moment she replied herself.

"I rather think they would not notice it, or at any rate not at first."

There were two Russias here in Manchuria. One was combating death, while the other stood idly by in the same neighbourhood. When Zabolotny asked for more funds to continue the struggle against the epidemic, the official in charge of city finances gave the following reply.

"After all, it is chiefly the concern of the Chinese and, of course," he added after a second's thought, "of the few European fanatics working on the epidemic."

Beyond the deserted expanse, in Harbin itself, there had never before been such wholesale drunkenness, bribery and perversion as in the winter months of the year 1911.

There existed a strange, or rather a terrible, indifference to death. Actually it brought the little group of workers at the Moscow Plague Centre closer together; without this close team spirit, the work would have been impossible.

From the earliest days it became clear that the lethal power of the Manchurian strain of plague microbe, its virulence, was considerably greater than had been observed during previous epidemics. In Manchuria it was the pneumonic form of plague that was raging and *all* who caught it invariably died. The serums and vaccines made from cultures of ordinary strength had almost no effect.

Every time Zabolotny arrived at the Moscow Centre, he warned the staff:

"Take extra special care!"

But it was difficult to follow the advice.

The local people feared that if plague were discovered, the sanitary authorities would burn down their homes and property; consequently they did not report cases of sickness. The dark, narrow streets of Fukien and Harbin had to be searched, each home, one *fanza* after another. It was Lebedeva who penetrated into the darkest corners. When other doctors appeared the people whether sick or well would run away from their homes, doss-houses and opium dens; but they were not in the least afraid of Lebedeva. Although she did not know their language, she seemed to understand each one of them. The other doctors fought the disease as a whole, the entire epidemic, in the dark shadow of which the fate of the individual is lost. But the sum total of tremendous misery did not prevent Lebedeva from responding heart and soul to the boundless misery of each individual. From the first moment the patient met Lebedeva, he felt that he mattered to her, that if necessary she would give her life for his sake, and his alone.

Just as the soldier's exploit on the battle field includes both readiness to face death at all times and also tireless, perpetual work day and night, so, during an epidemic, the supreme exploit, the moral strength of the human being was measured not by the extent of the danger alone, but primarily by the total work which, in the given situation, the person had to perform, the work into which he had put the whole of his heart and strength.

There were not enough guards; the people put into quarantine ran away, carrying the infection into the town, and the work had to be started all over again.

One night Zabolotny was making his rounds on the outskirts of Harbin when he heard the soft, intermittent wail of an infant. The dilapidated *fanza*, from which the plaintive voice came, stood with its door wide open to the hard winter frost. Zabolotny approached and shone his lamp into the narrow closet. Through clouds of frosty steam he saw, lying on a low bunk in the corner, the dead body of a Chinese woman; a tiny boy, quite naked, was pressed to her breast.

Near by lay a ragged blanket. Evidently the mother's last instinctive movement had been to try to get to the infant and cover it warmly, but she had died before she could do so. The infant continued to wail. Perhaps it was because of the frost that the women's face remained unchanged: she seemed to be listening to the cry of her son, to be reassuring him, whispering tender words, unheard and unheeded by others.

Zabolotny picked up the child, wrapped it in his fur jacket and went out of the *fanza* into the street. It was a clear and frosty night. The child grew quiet: it lay with its eyes open, looking tranquilly from its furry lair. Later its eyelids drooped and it slept, from time to time shuddering and crying out in its sleep.

Zabolotny remembered Kiev and the hard student years when often there had been scarcely enough money for bread. When they could buy sugar and tea as well, Lyudmila would say happily: "We've got a real treat today!" He remembered the first and only child born to them, its short life, its death.

When he reached the quarantine building, Zabolotny handed the child to Snezhkova, one of the Moscow Centre medical sisters. As he walked back home, the idea struck him that he might adopt the infant. If it were left to its own fate it might, after all, die if not this year, then next, if not of plague, then of famine.

He met Lebedeva and gave her the details of the plan which now seemed to him not just possible, but the only possible one. He had even thought of a name for the child, Yan.

"Yan Danilovich Zabolotny is a good name, in my opinion," he said to Lebedeva.

"I think so too, very good," replied Lebedeva.

It was not clear whether she was referring to the well selected name or the whole plan for adopting the child. Lebedeva returned with Zabolotny to the quarantine centre, because Zabolotny wanted her to see the child at once. They found Yan Danilovich peacefully sleeping with the same serious, surprised expression on his face as when he was awake. Zabolotny knew that it was rare for a breast-fed child to contract plague, but all the same he could not throw off a feeling of constant anxiety.

He stayed at the quarantine centre until a messenger arrived from the hospital summoning him to a serious case. When he at last returned home, he stayed up to write a letter to his wife. It ended with the words: "Did not I tell you it is by no means all terrible, dark and dismal here? Working on an epidemic, one need not always lose; one can sometimes gain."

Although it would seem that the medical work took up all the time and all available forces, nevertheless scientific research never ceased for a moment. Zabolotny carried out his plan to the letter: the practical work did not prevent theoretical research on a large scale to discover the sources of epidemics. The battle was on two fronts: against the epidemic already raging and against epidemics which might break out in the future.

The most careful laboratory research showed that there were no epizootic diseases among rats. The sources of epidemics should not be sought there.

An Anti-Plague Conference was convened in Mukden. Zabolotny represented Russia, Kitazato—Japan, Galeotti—Italy, Martini - Germany, Petrie—England, Strong —America.

The conference of international scientists joined cause with Zabolotny's opponents. The Mukden resolution stated: it is not proven that epizootic diseases among rodents had any influence on the original spread of the disease.

Again Zabolotny found himself isolated. The scientific representatives of Western Europe, America and Japan did not want to admit that he was right, and follow the road he was struggling along almost alone.

When the conference closed, all Zabolotny wanted was to get away from the stifling atmosphere of the conference hall and from Mukden, to be back "home" at the Moscow Plague Centre. On his way out a man of medium height with a wrinkled face and skin that was of yellowish-brown tint, due either to sickness or the hot Manchurian sun, stopped him by the doorway.

"I represent a number of American newspapers, ten million readers, professor," he said, by way of introduction. "I would like to ask you a few questions. I won't detain you, we can talk quite well as we go along."

Zabolotny did not reply and the little man took his silence for consent.

"One of your colleagues," continued the journalist, "asserts that epidemics should not cause particular alarm because, in the final count, death from plague is easier and quicker than, say, from starvation."

"A colleague, did you say?" queried Zabolotny. "No colleague of mine said that."

"Then you don't agree? Yet Thomas Robert Malthus who, I imagine, is well known to you in Russia, proved a hundred years ago that it was necessary to restrict populations, and he mentioned two things that assist in this. You, of course, recall them: famine and the corruption of morals which leads to..."

Zabolotny strode ahead rapidly and the little man panted along at his side.

"Thomas Robert Malthus was a Surrey clergyman, a man of high morals and most learned, professor. You know his brilliant works and will agree that starvation or, at any rate, epidemics are better than..."

The journalist had no time to finish the sentence. Zabolotny faced round sharply and said angrily:

"Clear off at once! Go to hell!"

Zabolotny spoke in Russian. Perhaps the American pressman knew Russian or else the expression on Zabolotny's face required no interpretation. At any rate the little man fell back a step, removed his hat for some unknown reason and simultaneously made a polite bow. Then he turned the corner of the street and disappeared.

To Zabolotny's mind it had grown lighter and the town looked altogether better than it had a second ago. He strode on through the broad, straight streets. A wall covered with yellow porcelain tiles surrounded the ancient palace of the Manchurian emperors. Some of the tiles had been broken by bullets. The unrepaired damage on the walls of neighbouring buildings and the traces of fires called to mind the battles that had roared over the city. Now plague had broken through the city gates.

Zabolotny would have liked to forget about the journalist, but he could not dismiss the encounter from his mind. In the history of science there were people whom Zabolotny dearly loved and others he hated and despised with all his heart. First place among those he hated went to the "man of high morals" from an aristocratic parish in Surrey, the well-fed humbug who recommended poor people to die of starvation or disease, because it was moral and necessary that they should.

"Thomas Robert Malthus ..." muttered Zabolotny to himself. "And he pronounced the name as though he was God Almighty or the Blessed Virgin Mary. ..."

The streets became narrower. Here artisans of one craft lived huddled together. The metal-workers' street ran into the saddlers' street. There were long poles before each house in the street where the dyers lived. The breeze flapped the purple, black blue and grey strips of material so that they looked like the flags of some unknown states. The smallest street of all, perhaps, was that of the jewellers, and the longest was that where the coffin-makers lived and worked.

The encounter with the American journalist was not quite in vain. Zabolotny soberly pondered over the events and impressions of the day, seeing them from a new angle.

At the morning session of the conference one of the delegates had shouted out a remark while Zabolotny was speaking. It was:

"First of all caution, wise caution as to conclusions."

Was not this perhaps more than just wise caution?

Nearer the outskirts of the city the architecture became more varied. Flat-roofed buildings came into view, the kind that are commonly built in Mongolia, where hurricanes might blow off an ordinary gabled roof. Here were ponds of thick, dark-brown water in the hollows made when the clay was extracted to make the buildings. Here there were more traces of fires and wrecked shops than in the centre of the city, traces which persistently reminded one of the city's history.

In 1840 British soldiers had been sent to this distant country to force the Chinese to buy opium from the East India Company. This disgraceful expedition was described in history as the first Opium War. In 1856, when the Chinese detained the "Arrow," a British coasting vessel carrying a cargo of contraband opium, the British sent another punitive expedition to China. This marked the beginning of the second Opium War. For China, opium was a calamity not less terrible than plague. Previously, Zabolotny had never for a moment imagined that it was possible, apart from motives of profit, to try to justify these wars of plunder. If people were unwilling to poison themselves with opium, they must be forced to become dope fiends, because it is advantageous and produces sure profits! The East India Company assassins had protectors, the British army. Opium curtails the life of the human being and cripples people, but it is profitable, so it follows that one should kill in order to spread the use of opium!

Previously Zabolotny had imagined that an impenetrable wall separated the British East India Company and British science from each other. But he had learned to realize that, besides the science of Harvey and Jenner, there existed another science, Malthusian science. Malthusian science was disseminated by hundreds and thousands of advocates like the little man who wrote for tens of millions of American readers. It was soaked in poison and behind the old, noble words about the struggle for human lives one saw ever more frequently an almost unconcealed indifference to human life, an unwillingness to fight for it.

Perhaps there was something more than just "wise caution" behind the half-hearted, nebulous decisions of the International Anti-Plague Conference.

These were gloomy thoughts, indeed. Yet they quickly gave way to others, to the thought that at the Moscow Plague Centre there was not a single person infected with Malthusianism. It was a very small staff, but each individual could be relied on as much as Zabolotny relied on himself, and in the given circumstances this was all-important.

Zabolotny arrived in Harbin late in the evening. The staff were evidently waiting for him, because although it was so late, no one had gone to bed.

They were seated round the common table. Dr. Pallon retired for a moment, to return with a bottle of wine which she placed ceremoniously on the table. It was dark red and left an almost black sediment at the bottom of the glass.

"A toast to victory!" proposed Ilya Mamantov.

The wine was dry and raw, but it nevertheless reminded each of them of what, to him, was best: some of St. Petersburg and the friendly student board; others of the southern sun and close friends. It warmed the hearts of those who stood by the table, glasses in hand, and it made them fully conscious of the ties which linked the small group of Russians with the great people that had sent them to the aid of another great people.

"A toast to victory?" Zabolotny asked. "You know, my friends, it wasn't so very much like victory. Nothing like it, in fact. Still, they say in the army that to lose bad allies is half the victory. And what allies they were! At any rate it is good that we now know that victory depends on us alone. And I firmly believe, more firmly than ever before, that we shall soon see it."

After visiting little Yan, seeing the sleeping child and asking in detail about his health, Zabolotny returned to his own room. He found a packet of letters, the accumulation of several days, lying on his desk. He recognized Vysokovich's familiar handwriting and rapidly tore open the stiff blue envelope. It was very painful to read the lines, from which it became clear that his old colleague of the Bombay epidemic days was wholly supporting the sceptics.

"It has in no way been proved that *tarbagans* suffer from human plague," wrote Vysokovich in his firm, large handwriting.

Zabolotny read the phrase several times.

"It's not such a pity to lose allies like those at the Mukden conference," he thought, "but friends, brilliant, selfless scientists like Vysokovich.... Ah well! Sometimes one has to part with a friend at the cross-roads, when the road takes a sharp turn."

Then, surprisingly, Chinese, German and British merchants intervened in the scientists' dispute. To admit that *tarbagans* played any part in the spread of epidemics would mean restricting the trade in pelts obtained from the danger areas. People, who were quite indifferent to the death of 40,000 people, sounded the alarm as soon as the danger touched the incomes they obtained from the fur industry.

"It is not proven!" repeated the merchants and industrialists from Mukden to London. The decision of the Mukden International Conference was just what they wanted, for it allowed them to continue their profitable *tarbagan* industry without taking the slightest precautionary measures.

Zabolotny was able to observe, what was not a rare case, that when faced with the danger of losing profits amounting to several millions, certain indifferent people suddenly became enemies. Their position of neutrality towards the forces of death changed to open alliance with them. It seemed as though, were the need to arise, these people would send in soldiers to guard the sacred immunity of the plague-carrying *tarbagans*, just as they had twice sent hireling armies to defend the opium-carrying traders.

"It is not proven!"

There was only one answer to this: he and his colleagues would not retreat until they had made a complete study of the experiment which nature had set before them, and which had cost 40,000 human lives, until they finally had the indisputable right to say: here are the causes of the epidemic and here are the conditions under which it will never break out again.

Research into the epidemic and the tense struggle against plague continued simultaneously, although the little group at the Moscow Plague Centre lost one member after another.

On January 11, a student by the name of Suvorov went up to Lebedeva as she stood outside a *fanza* in Market Street.

"I've examined eleven people, all of them seriously ill, and have discovered three dead bodies; but there are a lot here, the *fanza* is stuffed with dead and dying. I've never seen such a crowd of sick people," she said.

Suvorov wanted to enter the *fanza*, but she prevented him.

"There's no need to. I've been in."

"But aren't you afraid to go into such places?"

"It makes no difference to me now," she replied with a shrug.

She had a muslin mask over her mouth. She stood there for a long time, her arms hanging loose at her sides, her thoughts far away. At last she turned and looked at Suvorov.

"I'm just terribly tired," she said in a low voice. Then in a totally different tone of voice, speaking steadily, she said: "You can't get into the attic by going through the *fanza.* The roof will have to be taken off."

Members of the disinfection squad arrived and quickly carried out their instructions. Lebedeva climbed up the ladder and through a break in the wall, and found herself in the attic. When her eyes became accustomed to the darkness, she saw one dead body opposite the break in the wall, to the left in a corner was a second, in the middle of the room a sick man was writhing in his death agony and yet another, in the farthest corner, was vainly wrapping his leg in a blanket, and unwrapping it again, all the while quite unconscious of his surroundings.

At the conference of doctors that evening, Lebedeva reported the new hotbed of plague discovered in Market Street. She returned home after the meeting at one o'clock in the morning and went straight to bed. Four hours later she was up again. It was still quite dark, but she did not make a light in order not to wake other people in the room. Dr. Pallon woke up.

"Where are you off to?" she asked. "It's still very early."

"We must finish investigating Market Street," Lebedeva replied. "It's in a horrible state."

Dr. Pallon noticed later, during dinner, that Lebedeva seemed a little excited; her face was flushed and her movements jerky, and her nerves seemed to be on edge.

Lebedeva took her temperature several times during the day. By evening there was a slight fever; she sent her sputum to the laboratory for analysis. While waiting for the result, she locked herself in a room and worked hard, to complete the report she was making on the results of investigations in the area for which she was responsible. She worked without a break until the evening.

When Dr. Bogutsky knocked at the door, she opened it and quickly drew back to the wall. On the table lay the rough notes and the final report, written in clear, even handwriting.

Lebedeva was the first to speak.

"So you've come, and that means you've found plague. It is just what I expected." Then she pointed to the papers and added: "Take them after the disinfection has been done. I tried to put in everything of importance. The main centre is in Market Street. There must be no delay. And you know what else: see to the other doctors. Every one of them may become infected and then infect the next, then there will be no one left to do the work. We mustn't go on living like we do now, all huddled together in a sort of mousetrap."

THE MANCHURIAN PLAGUE RIDDLE SOLVED

Ilya Vasilyevich Mamantov fell sick exactly a month after Lebedeva. He had been trained at the Alexander Cadet School and had later joined the Pages Corps, which offered him a career at Court; but he had found the courage to break away from the life to which he was accustomed and so sharply change his direction in life. While still a student at the junior courses of the Academy of Medicine, Mamantov had worked at the Obukhov hospital and then helped to combat the cholera epidemic in Tambov and Ekaterinoslav. He had been one of the first to go to Harbin when plague broke out.

Mamantov remained in quarantine while he waited for the results of the analysis. Frequently he recalled Petka Besfamilny, a 12-year old lad with a thin, pale face, who had lain in Obukhov hospital. Petka had been very ill and knew it, and when Dr. Mamantov examined him, he would always repeat a phrase he had picked up:

"No, I'm not for this life, that's the trouble. . . ."

Mamantov had spent days on end at the boy's bedside and had literally wrenched him from the clutches of death. Petka had begun to get well, but continued to lie with the same strange, listless, indifferent expression on his face.

"What's up, old chap? You'll soon be quite well and can then go home," Mamantov happened to say to him one day.

"But I haven't got a home, Dr. Mamantov."

"Where have you been living, then?"

"At Nikandrov's, the bootmaker. My father no sooner apprenticed me to him, than he went and died."

"Then you'll go to the bootmaker."

"But what use would I be to him now? His samovar weighs a ton, and I'd never be able to lift it, ever."

Mamantov had adopted the boy and now, as he lay in quarantine, the thought worried him all the time: what would happen to Petka if he were to be left all alone again?

Nine analyses gave a negative result, but the tenth revealed plague microbes. When Mamantov knew the results of the tests, he wrote home to St. Petersburg:

"Dear Mama, I've picked up some germ and am ill, and since on this plague work no one gets anything except plague, it follows that it's plague I have now. Mama dear, I'm terribly sorry this will grieve you, but I can't help it. I'm not to blame, because I took all the precautionary measures I promised I would, when I was at home.

"I swear there was no desire on my part to show off or take risks. On the contrary, I felt that there was nothing better than life, yet I couldn't, out of a desire to save my life, run away from the danger that all the others are subjected to and, it follows, my death will simply mean that I kept my oath that I would do my duty. And however it may hurt you to do so, you must recognize that the life of the individual is nothing compared with the life of society, and that for the future happiness of mankind, sacrifices are necessary, when all is said and done.

"I firmly believe that this happiness will come, and if I had not caught plague I would have been able, I am convinced, to live a good and honest life doing everything in my power for the benefit of society. I'm perhaps a little sorry that I have done so little, but I hope and am sure that many people will now give all they have for the happiness of everyone, and will not spare their own lives, if necessary. It is only a pity when one dies for nothing, without achieving anything. I do hope my sisters will do work of this kind.

"I can just imagine how grand it would have been for me to have worked with them, but since it cannot be, there's nothing for it. Life today is a struggle for the future. One has to believe that it is not all in vain, and that even though it may be through much suffering, mankind will attain a real, human existence on earth that will be so splendid that people will be ready to give up all their personal interests and life itself for the sake of this idea alone.

"Well, Mama, good-bye. Take care of my Petka.

"Greetings to everyone. I must still write to Sasha and Masha and of course I will still have time to.

Your Ilya."

Lev Belyaev, Vladimir Mikhel, Maria Lebedeva, Ilya Mamantov, sister Snezhkova and many other doctors and students are buried at Harbin cemetery. The Russian civilians who freed Manchuria from plague now lie side by side with the Soviet soldiers who more than thirty years later drove the Japanese fascists from that country, side by side with the soldiers of the Chinese People's Army who died fighting for a new life in their country.

* *

By the following spring the heroic work of Russian and Chinese doctors ended in victory over the Manchurian epidemic. But Zabolotny and a group of assistants remained in the country. Now that plague had again passed into its invisible, concealed form, every effort was required to seek out the tracks that were lost.

Soon epizootic disease was found among *tarbagans* near Sharasun station. Zabolotny and his assistants investigated the area mile by mile. While out on field work one day, he caught sight of a *tarbagan* slowly moving along the railway track, staggering as though it were drunk. Isayev, one of the students, caught the sick animal. A day later the laboratory animal was dead. The autopsy showed a classic picture of plague, with the characteristic jugular buboes.

Now it was for the microscope to pronounce the verdict. Slides were prepared. Zabolotny saw plague microbes obtained not from the blood of a human being, not from rats or animals artificially infected in the laboratory, but plague in the wilds of nature, plague in the natural fortress it had spent thousands of years to build.

He saw plague which was still alive, though the epidemic had ended; he saw microbes on the march, disease at its half-way house between one epidemic and the next.

Zabolotny felt that extreme pleasure in the power of his science that fills the whole being; the pleasure felt by the astronomist who, after foretelling the existence of an unknown planet, at last sees it after many years, or the pleasure of the chemist who, after a thousand experiments, at last separates out, in his crucible, the element he foretold and has found.

Incidentally, this was not simply a splendid discovery, pleasing enough in itself like everything that adds to our knowledge about nature, but also a most important victory of life over death.

The terrible winter of 1911 came to an end. For the first time in his life, in the whole of the long history of science, the scientist had the right to say what should be done, what conditions should be created, in order that such a winter would never be repeated.

Pure suspensions of microbes were obtained from the dead body of the *tarbagan*. When other *tarbagans*, rabbits and guinea pigs were infected with these cultures, they died, showing obvious symptoms of plague. The discovery had stood the test of most important laboratory experiments.

One could burn the bodies of all who had died of plague, one could completely destroy the "bridge of death" about which so much had been said, but it did not follow that plague would vanish. It was not just waiting in graves for a suitable moment; it was alive and in living nature.

It was *alive*! Now no one could deny the truth.

Not microbes dormant in dead bodies, but epizootic disease, diseases among animals, maintained the continuity of the existence of plague infection. The interval between epidemics might last a year or be prolonged for a hundred years. In either case the danger still existed. The epizootic outbreaks could smoulder, flare up and almost die down, until a string of circumstances led to the disease again penetrating into the human sphere.

It was as though an invisible Bickford's fuse stretched across the steppe. It crossed the steppe in all directions, a smouldering, meandering fire of epizootic diseases. When it coincided with the path of mankind, someone became infected with what the local inhabitants called *tarbagan disease*. Later, if the doctor did not recognize the nature of the disease and the sick person was not isolated, then this single case of disease, given certain conditions, served as the cause of another outbreak of epidemic.

By June 20 the laboratory experiments were finished and Zabolotny telegraphed the results from Harbin to St. Petersburg:

"The supposition long held is confirmed: that so-called *tarbagan* disease is nothing but bubonic plague. This observation is of great importance for plague epidemiology, since it explains very simply the origin of the plague epidemics in Manchuria."

The task put forward in Vetlyanka in the autumn of 1878 was fulfilled thirty-three years later in Manchuria, thousands of miles distant from the Caspian area. Thirty-three years of searchings, of dangerous work by Russian scientists!

After discovering the part rats played in carrying disease, quarantine doctors used rat-guards on ships' hawsers to protect port towns from the uninvited guests. Plague was gradually eliminated from Europe. It is unlikely that in the history of science there has been any other discovery that gave such tremendous results and yet was simpler than these rat-guards. Almost an entire continent was in this way rid of disease.

Rats were found to be the first storehouse, the first fortress of plague. N. F. Gamaleya's investigations during the Odessa plague outbreak finally revealed the role played by rats. Zabolotny discovered the second storehouse, the second *tarbagan* plague fortress. This meant that the thousand-year reign of plague on another continent, Asia, was coming to an end.

The plan of struggle now suggested itself: a network of small laboratories had to be organized in the steppe. These laboratories could spot and make observations on each outbreak of epizootic disease and then, after informing the population, could use the simplest sanitary measures to protect the people from the danger of infection.

The observation points, small laboratories situated throughout the whole of the steppes, would act as lightning-conductors. As the lightning-conductor catches on its point a charge of electricity capable of causing vast destruction, and conducts the power into the earth, so the laboratories, which for the time being did not set themselves the task of finally destroying plague, could already "conduct" it into the earth, could prevent the plague microbes from entering the human sphere, could avert epidemics.

This was the operation to encircle the storehouses of the plague microbe.

Zabolotny's simple formula "epizootic disease among *tarbagans*—the human being—epidemics" solved the problem of the Manchurian plague.

But there are no *tarbagans* in the Caspian area. Science had to find out what animal there, in the Volga steppe, played the role of plague storehouse.

THE CASPIAN AREA

In this story, generations of scientists appear one after another and blaze the trails leading to the goal which had been contemplated decades earlier.

Danilo Samoilovich and Pogoretsky; Koch, Morozov and Minkh; Vyzhnikevich and Khavkin; Lebedeva and Mamantov.

Each of those who took part in this work knew that others would come after him to continue the struggle: it could not have been otherwise.

It was the great scientist Pavlov who said: "Remember that science requires of man the whole of his life. And if you had two lives, they also would not be enough for you." Not two, but dozens, sometimes hundreds and thousands of lives are needed for an idea to be realized. And so it is all a matter of whether you have someone to continue after you, a second life, a tenth or hundredth life, a matter of whether your idea, your science, your people, possess the power of immortality, of performing the exploit which is not restricted to one life, no matter how great and noble that life.

It was Daniel Zabolotny's fortune to experience the greatest happiness a scientist can know: to see pupils rallying to him, a school of young scientists who were developing and growing strong in the process of performing dangerous work. This group of scientists went forward despite inevitable losses and in the teeth of the icy indifference with which imperial St. Petersburg surrounded every experiment Zabolotny undertook.

The plague scientists conducted their struggle on a broad front. Even when the Manchurian epidemic was at its height, Zabolotny kept a close watch on how his comrades were working on another flank of the plague battle, in the Caspian steppes, which was the oldest and, for Russia, the most dangerous centre of infection.

Ippolite Alexandrovich Deminsky, a young doctor, moved to Astrakhan with his family, after graduating from Kazan University. He found it hard to make a living. The town was divided among the old, experienced doctors and he had to win a practice from one of his colleagues. Deminsky could not do this. He would sit all day long in the little reception room listening for the doorbell to ring. There was never a sound. By the time evening came he was tired of waiting idly, and he would go out and wander about the town, always taking the same road through winding back streets, round the market, past the hovels blind in the darkness and smelling of damp, until he reached the port. In his pocket was the new stethoscope which had never once been used; it seemed as though the instrument transmitted to him all the crepitations of this sea-side town, where cholera spread from the market to the side turnings, where darkness produced rickets, where rheumatism, consumption and heart diseases flowed in with the swamp mud from docks and fishing quays.

Deminsky's mind was at work as he proceeded on his way, taking firm strides, heedless of the puddles. His boots and the hem of his coat were splashed with mud; they were never dry in this damp atmosphere of the fishing port.

If only he had time and money to examine all these back streets, all the children playing in the road, everyone he met, every hovel with its boarded, rag-stuffed windows!

What beastly and degrading stupidity it was. Such a crying need for medical workers, yet he had to go chasing after a practice!

Then he would return home, open the front door stealthily, but his wife would recognize his step, meet him on the threshold and search his face to discover whether the news was good.

"Were you called out to a patient?" she asked.

"No!"

To avoid further conversation and in order to be alone with his thoughts for a few more minutes, he quickly slipped into the living room and sat down at the piano.

"Would you like something to eat?"

"No."

He played her favourite tune. It was strange that his wife had never once asked him the name of it, though she had heard him play it many times.

There was a conflict of bass notes filling the room with an angry, rumbling confusion of sounds, then suddenly, at first scarcely perceptibly, something new broke into the dark, heavy waves of sound, something that made one want to huddle into the corner of the divan: a chill, tinkling chime. It was repeated more clearly, coming like light through darkness, and with each repetition new sounds were woven into the transparent pattern of the melody, like faint lights becoming more and more visible. It conjured up some town on a distant shore. She had never been there, but she knew every tower, every window, every merlon of the walls, picked out in lights.

When she first met Ippolite Deminsky, this music had seemed to describe what lay before them: a promise that one day they would sail to some bright shore! But here they had come to Astrakhan from Kazan, and every day life became more difficult. There was the rent to pay, and that very day the landlord had reminded them of it. But they had no money. Apparently they would have to leave this home, too. Where would they go?

The sounds came nearer. They were almost palpable, almost visible. What was this bright shore he had been telling her about for so many years?

The next day Deminsky left home early in the morning. When he came back, he told his wife that he had finally accepted work as a public health officer at the fisheries. He explained that it was hard to part with his family, but he had no alternative. He could no longer sit and wait for patients to come to him, and he would never agree to become a prosperous bedside doctor, a sort of guardian angel dancing attendance on ladies with migraine.

"I've tried. I simply can't do it! We'll manage to get along somehow."

His wife merely nodded.

He took off his glasses and his eyes, myopic and distressed, looked into hers.

"I can't act otherwise," he repeated. "One can sacrifice everything in life for a loved one, even life itself, but one cannot give up the most sacred thing in life—the aim of life. How could one face life, if one did? It would be living in a story book, selling one's soul to the devil. You wouldn't want me to do that, would you?"

AT THE FISHERIES

Ippolite Deminsky left Astrakhan at dawn, travelling in an old covered cart which smelt of tar and fish. The streets dwindled into narrow back streets. Beyond the dumps, allotments and open spaces of the suburbs lay the steppe. A warm smell of sun-dried grasses was wafted towards him. The rare hills lay like islands on the deep blue of morning which enveloped the lowlands. Against one of the lower cone-shaped hill-tops, the silhouette of a marmot, alert and standing on its hind legs by its burrow, was sharply outlined.

By evening, Deminsky reached the place where he was to work, and without as much as a glance at the inadequate corner of the old barrack allotted to him as his medical centre, he went off to look at the fisheries.

By nightfall he returned to the barrack. On the rickety table he set up his microscope and the stand of test-tubes, simple laboratory equipment he had bought with his last money, before leaving home.

The wind whistled through the cracks at the windows. Outside was the blue-black steppe with its patches of salt-marsh, silvery and icy in the unsteady light of the moon.

The next morning he began to receive patients. For several weeks the whole of his time was spent examining patients and visiting the sick in the barracks.

Suddenly he had to discontinue the work at the fisheries. An epidemic had broken out in a Kirghiz nomad camp some 70 miles distant. Plague was suspected. But Deminsky arrived too late. It had taken time for news of the sickness to reach Astrakhan, for the people responsible to make up their minds which of the nearest doctors to send to the nomad camp, and for a messenger to ride over to the fisheries. Meanwhile the disease had wiped out the seven people who comprised the entire population of the *yurta*, and had vanished.

All round lay the barren steppe. In the *yurta*, the corpses lay under sheets heavily soaked in corrosive sublimate. The only living people were Dr. Klodnitsky and two nurses. Klodnitsky had only the day before returned to Astrakhan from another plague outbreak, and had been sent out to assist Deminsky.

The doctors finished their work by two o'clock in the morning. By then there was nothing left to indicate that there had been any human habitation; everything had been burned. A few gusts of night wind, and not even the ashes would remain, even the smell of burning would have disappeared.

No one felt inclined to sleep. While the nurses made tea, Klodnitsky thought aloud.

"So we've won another 'victory,' have we? Plague wanders about these parts on a tether hundreds of miles long, swirling from one nomad camp to the next. And we follow in its tracks like a group of undertakers. When shall we find the source of the disease? Shall we ever find it at all?"

"What's your attitude to Zabolotny's opinion on the significance of rodents in the spread of plague?" asked Deminsky.

Klodnitsky did not hurry to reply.

"How can I explain it?" he said at last. "You see, it's all just hypothesis, and where we work we have been unable for such a long time to find any confirmation of it, that one can't help doubting whether we'll ever find it. We'll go on searching because it's our duty, but shall we ever find anything?"

Deminsky said good-bye to Dr. Klodnitsky, for it was time to return to the fisheries.

The horse proceeded at walking pace, but he did not urge it on. He was pondering over Klodnitsky's words and what he had recently read in Zabolotny's article, the meaning and bold, daring force of which had only now become clear to him. "Plague wanders on a tether." What sort of "tether" was it? The living world of the steppe?

Of the many illnesses he had encountered during the past week of work at the fisheries, two of the most dangerous were closely associated with these parts; they seemed to be part and parcel of the district. The roots of cholera stretched to the Volga canals; plague, judging by information found in literature and from what Klodnitsky had told him, had also for long ages had deep roots in the Astrakhan steppe. To put an end to these diseases one had to search out and track down these roots.

Thus he set his foot on the road which he followed to the end of his life.

The horse made slow headway, sometimes stopping to nibble the dry grass. The rider gave the animal its head.

In Astrakhan, wandering about the slums round the market and quayside looking for the sickness which, being a doctor, Deminsky could not fail to see at a glance in everyone he encountered, he obtained a clear picture of the common cause of all these sufferings: poverty, the hopeless life of excessive toil, dirt and darkness.

The picture that confronted him, after the night at the Kirghiz camp, was much more complicated. Beyond the bedside of the patient in Astrakhan, the doctor saw a sick town. Here, outside the sick town, he saw the natural countryside as a habitation of disease.

The normal round of work was waiting at the fisheries. After his surgery hours, Deminsky set out on his tramp along the estuaries and the Volga canals. When he returned he made a careful study of the samples obtained during his wanderings. The cultures produced a growth that was typical of cholera vibrio. In the stipulated time the nutritive protein solution became covered with a delicate, almost invisible film. Gentian-violet, Lugol's solution, alcohol and fuchsin were used on the slide containing the specimen. When treated with bacterial stains, one group of bacteria turned blue, the other, containing cholera and plague microbes, first became colourless and then took on the colour from the fuchsin stain.

The bacteria invariably became stained in shades of red, as is typical of a culture of cholera vibrio.

Evidently during an epidemic the microbes were brought down in streams and tributaries from surrounding villages, and were carried into the Volga and subsequently broke into the town by way of the backwaters and canals.

The excursions became longer and longer. Sometimes the traces of cholera were lost: no culture grew on the nutritive solution. The path of infection seemed to vanish. Weeks of wandering and scores and hundreds of swabs were required before a new line could be drawn on the map, restoring the path of the disease.

In the autumn, Deminsky returned to Astrakhan from the fisheries. He had grown very thin and his face was covered with a dark tan. He brought back a map from the fisheries on which he had entered all the water-ways infected with cholera, and also his notes on the measures required to be taken to prevent epidemics.

Late that evening after a long talk, his wife asked him:

"Have you noticed the changes here?"

Deminsky looked carefully round the room.

"The piano? You were quite right to sell it."

There was a note of indifference in his voice that made her shudder. Music bound them to each other, linked them with the past and the wonderful dreams which had been, or seemed to have been, common to both of them.

Before presenting his report to the town authorities, Deminsky read it over to his patron, Gorbunov, an old Astrakhan doctor. As he listened, Gorbunov left his chair from time to time and paced the room. He put on his pince-nez, looked long at the map, then suddenly, with his back to Deminsky, said with what seemed uncalled-for irritation:

"I'd prefer not to give my opinion. This all pertains to the lofty spheres of science, so fashionable nowadays, and I'm an ordinary mortal, trained in the old down-to-earth ideas which are closer to the ordinary, simple human being. I was brought up to believe that if a doctor has not killed anyone, has not given treatment carelessly, unskilfully or negligently, but has helped five, ten, or (one may dream of that too) hundreds or thousands of sick people to rid themselves of a premature journey over Styx, the river of death, then he has not lived in vain, and deserves perhaps not a monument but at least to be remembered by the people. But here you are with experiments and hypotheses that have no relation to the fate of the ordinary little man and doctoring. I will not undertake to judge, from my own modest, restricted point of view."

He removed his pince-nez.

"And you'll forgive my rudeness," he added, heatedly. "But here you are, preparing to soar into the heights, when you've built no nest nor provided for your family, nor guided any small feet on the path of life."

Deminsky sat for a few seconds, his head bent, and turned over the pages of his report. Then he spoke hesitatingly and with obvious difficulty.

"Why must you say all that, Nikolai Alexeyevich? After all it's not at all my idea. And does it really only boil down to trying to save the life of a man, when death has already pinned him down and is suffocating him? What about meeting death out in the open, not letting it touch the little man for whom you, during your lifetime, have done so much? What about trying to destroy at least some of the diseases in the town? And why only in the town? Why not in the country, throughout the world!

After all, it is possible. Zabolotny is dreaming about it and working on it. And as for my family..."

Gorbunov interrupted him by rapidly stepping across the room to embrace him.

"Don't take what I've said to heart; forget about it," he hurried to explain. "It was said from the viewpoint of my own little nesting-box. You have falcon's wings, I feel and know it very well, I've always known it. Only will you reach the heights? May you reach them, and not fall and kill yourself."

Without taking leave of him, Gorbunov flung an old-fashioned cape over his shoulders and hurried to the door.

It was difficult, indeed, to fly.

Deminsky's report went the slow round from one provincial official to the next. Finally, four months later, Deminsky was called up for an interview. The official in charge of the business had bloodshot eyes and flabby cheeks. The ragged cuffs of his uniform, which was green with age, testified to his poverty and lack of success in his official career.

Deminsky talked with increasing enthusiasm about filters for purifying water, about a system of sanitary inspection being only the beginning, and about it being necessary to make a large-scale epidemiological study of the whole of the Astrakhan District.

"This is all mentioned in the report. You've presumably given it your attention! The next thing is to make a study of plague. When you read the news of the plague outbreaks which continually occur in the steppe, isn't your heart, like that of everyone living in Astrakhan, filled with alarm?"

The official listened with his red, inflamed eyes half shut. Deminsky continued.

"It is not as yet possible to draw the same conclusion about cholera, but plague is endemic in these districts, it is a feature of them, it lives here. It is possible that the vast expanses alone prevent the isolated sparks from setting light to the conflagration, but there may be a sharp increase in the steppe population very soon! Isn't that so? The discovery of valuable minerals—and there are already signs of this—the future use for agriculture of the Volga's inundated lands and of sandy steppes, all this should produce a stream of colonists, if not now, then in ten or twenty years' time. Can we, with a clear conscience, throw the doors open to them, and have we the right to do so? Suppose disease escaped from its confinement in the steppe? This is the chief, nation-wide danger of endemic centres, about which Daniel Zabolotny is warning us."

Deminsky stopped talking and suddenly felt very tired. He had a feeling his words were stones thrown into a bottomless well, that they were falling, falling, and the man was listening till his ears ached, yet he could not hear even the sound of the splash, the signal that the stone had reached the bottom.

Angry, black, municipal flies, drunk with the bitter inks of hopeless requests and unjust decisions, buzzed monotonously and bumped against the window-panes. Even the flies felt heavy and stifled here. The dust formed a black edging, which set off the curves of the low stuccoed ceiling.

The official said nothing, but waited patiently for his client to add anything else he might require to. When he saw it was useless to wait any longer, he said, in a dry, wooden, deliberately emphatic voice:

"It is not expedient!"

He handed back the report, on the corner of which the same decisive words had been written.

A moment later, his voice lowered to almost a whisper, the official added:

"You were hoping to obtain a position? I see! I see and sympathize. Or perhaps a contract? Many people come here now with their projects. But these things can't be done that way. You have to pull strings or produce cash!" He opened wide his faded, rheumy eyes, with the yellowed, bloodshot whites, and looked Deminsky straight in the eye as he repeated: "Or produce cash!"

THE SECOND VICTORY

Only when Deminsky was out in the street again did he grasp the full, insulting meaning of the official's last words. His idea had been buried before it ever saw the light of day. Yet Deminsky still believed with all his heart that his idea of driving disease not only out of the town or beyond the frontiers of the country, but from the face of the earth—no matter how fantastic it might appear at the time—could never be buried and that it was possible for the world to exist without disease, just as it was possible for the world to exist without poverty and famine.

Deminsky left Astrakhan to work as a public health official at the Baskunchak salt mines. They lay in the distant north-east area of the province. Beyond Lake Baskunchak stretched the sandy desert and farther on, to the east, this gave way to more dead salt marshes. The only thing that livened the monotonous, dreary landscape was Bogdo Mountain, the sole height on the horizon. Sometimes the winds would begin to blow and the air would fill with myriads of stinging grains of sand and become hot and oppressive; waves of sand would come to life and roll and break on the grasses. On the fringes of the steppe, the sandy breakers would try to drag up the roots of the plants which covered the steppe. Then, indeed, one saw that here nature was more than unkind, it was dangerous and difficult, everlastingly threatening the people with hot dry winds, dust-storms and encroaching sands.

Because nature was dangerous and difficult, it did not mean that it was always bound to remain so. Deminsky had a visit from a man who had been his best friend in their gymnasium days. He was Serge Korzhinsky, a brilliant botanist. During their leisure hours they explored the surrounding countryside. To Baskunchak they carried back seeds and runners from bushes and couch grasses which they collected on the front line of battle between steppe and desert. They planted and carefully tended them on the most difficult soils. Thickets of calligonum, tamarisk and lyme-grass, its long, narrow leaves bent to the ground by the wind, made their appearance at the salt mines.

There in the sand Deminsky laid out the beginnings of an experimental garden. He devoted every minute of his leisure time to the work. After one particularly cruel sandstorm, he went with Serge Korzhinsky to see how the young plants had fared. They cleared the sand from them and found that the grasses, though yellowed by heat and tortured by thirst, had not surrendered but had withstood the wind and were holding fast to the sand with their branching roots.

"You know, sooner or later you'll abandon your microbes," Korzhinsky said, when they had finished their round of the plants and were home again at the salt mines. "You should be a botanist, not a doctor. You might as well know it, it's in the blood."

Deminsky paused to think for a moment.

"I'll always be a doctor, of course," he replied. "That's my job for life, even if I live to be a hundred. But you know I really want to broaden the framework of my profession and to cure the world of plague, cholera, droughts and salt marshes."

At the salt mines the garden grew green and spread until it became a plot of land held fast by the grasses. Deminsky tried planting young oaks. There was not enough water for the trees, but the doctor contrived to get the first artesian well drilled in the neighbourhood of the salt mines; and so both workers at the salt mines and plantations of trees were provided with water in plenty.

Actually Deminsky could scarcely find time for the "green intervals," as he called his work in the garden. During the months and years after the memorable meeting with Klodnitsky, outbreaks of plague determined Deminsky's life. As soon as news arrived, a band of doctors and nurses would speed across the steppe to the danger spot. There they burned every article belonging to the patients, burned the dead bodies, just as they had done previously at the nomad burial ground. In a word they did everything recommended by science. But the disease survived fire and appeared again a hundred or two hundred miles away.

After work, worn out, though not downhearted, but rather angered at the futility of the measures taken, Deminsky would write to his friends in Astrakhan:

"Cry aloud that we are by no means doing what is necessary, that fire does not destroy plague. The epidemiologist must solve the problem of plague, not guardians of the law and sanitary inspectors."

But the cry was drowned in the vast expanses of the steppe. It was reckoned, in Astrakhan, that policemen, sanitary inspectors and fires were all plague deserved. At one conference, the Governor somewhat varied the usual formula:

"Fire and severity," he declared.

As soon as the last patient died, the allocation of funds was to cease.

A young doctor once asked Deminsky:

"How can you reconcile yourself, Ippolite Alexandrovich, to being constantly under the threat of death by plague?"

Ippolite Alexandrovich Deminsky

Deminsky absently fingered his greying beard and looked closely at his companion.

"There's no time to think of death, colleague, there's a great deal of work to be done! And I would advise you, before finally selecting your speciality, to think about whether you can tolerate these eternal wanderings from one plague centre to the next, and whether your family wants to be reconciled to eternal want. Our work is interesting, enviable even, but it requires that the doctor should devote his life to it. Just think that over, before it's too late."

It was most natural to assume that the role of chief carrier of infection, which in Mongolia was played by the *tarbagan*, would fall to the suslik, a kindred species of rodent in the Caspian area. But "what may be," even "what should be," does not at all signify "what actually is."

In 1911, Ilya Ilyich Mechnikov's expedition passed through the Volga steppes. The great Russian scientist and his assistants captured large numbers of susliks, caught in burrows or found dead from unknown causes out in the steppe. They studied them in laboratories according to all the rules of microbiology. Hundreds of cultures were made and thousands of slides examined under the microscope. Mechnikov's expedition dissected, as it were, the steppe, just as the pathologist-anatomist dissects a body to discover the cause of death. But the dissected, "microscope-examined" steppe failed to yield its secret. Not a single sign of the plague microbe was found.

During months of the bitterest disillusionment, the news arrived from Manchuria about Zabolotny's decisive results on that far-flung sector of the plague battle. Zabolotny returned like a conqueror to Moscow, with twenty *tarbagans* for presentation to the plague fort in connection with further experiments.

Several times Deminsky read the brief articles published in the "Medical Gazette," which told of Zabolotny's work. For it was a victory for the same school of microbiologists which regarded plague as a particle of the living natural environment and was seeking in living nature for the place d'armes where finally the disease could and would be conquered.

Decisive events were imminent in the Caspian area as well.

For dozens of miles along the Volga sprawled an area which included the village of Rakhinka and numerous hamlets scattered in the steppe around it. This particular year calamity befell Rakhinka: the area was infested with susliks. The fields seemed to be alive with overfed rodents. The invasion of rodents destroyed the grain crops and produced danger of famine.

All the villagers not engaged in work on the fields, chiefly old men and children, went out to fight the susliks.

Masha Morozova, a seven-year old girl from Romanenko hamlet, came back from the steppes with her friends and the following day had to keep to her bed; there she lay, groaning and crying, unable to lift her burning head from the pillow. Masha was the first victim of the epidemic.

There were only fourteen medical centres in the whole of the vast district with its population of half a million: five of them were under lock and key, the rest had no medical supplies.

The epidemic which began in the little village of Romanenko spread unhampered to other villages. Only then did the provincial administration devote attention to the dangerous outbreak of plague.

Seated beside Dr. Zabaluyev in a shaky cart on the journey from Astrakhan to Rakhinka, Deminsky showed no desire to talk. His face was drawn and from time to time he leaned forward as though to urge the cart ahead, then lay back on the soft hay with his eyes shut, seeming to doze.

"You're as impatient as though you were going to meet someone," said Zabaluyev, at last.

Deminsky hesitated before replying, then he turned squarely towards Zabaluyev.

"I can't forgive myself for the time that's been lost!" he said. "You remember these parts? Only three miles from here is Perevoznikov village where an epidemic began in 1903. Two outbreaks in one centre! And the reports say that there was an outbreak of disease among the animals, just before the epidemic. Here we can't fail to reach our goal."

Deminsky's constant companions, the laboratory guinea pigs, swayed in a hay-lined cage, just behind.

They arrived in the night. After some difficulty they found the district doctor. He came out on to the porch, sleepy-eyed, with a coat thrown over his shoulders. His face expressed indifference, or perhaps he was simply tired. He stood listening to the dogs barking and then proceeded to show the way to the medical centre. He walked on ahead, hunched up in his overcoat, and kept to the middle of the road: "The dogs might bite, they're ferocious beasts," he explained.

At the medical centre, which was a bare log cabin, the doctor opened a cupboard and tossed a small box on to the table.

"*Alamat*, as Kirghizians say in similar circumstances: a 'wholesale calamity,' " he said. "And all I have is two grams of quinine, a table, a lamp without a glass; this last, of course, in order to throw a brighter light on the road to progress."

Without replying, Deminsky, with unnecessary haste, laid out the surgical instruments, apparatus, chemicals and laboratory vessels he had brought with him. He placed the bacterial stains: gentian-violet, Lugol's solution, alcohol, fuchsin, in their usual order.

When he had finished he sat down on a form in a dark corner.

"This is my tenth camp laboratory," he said, out of the darkness. "Perhaps it will be the last. Here nature is putting her cards on the table. Do you feel it: plague breathing all round us? You know, I read a report in Astrakhan from the deacon of Romanenko village. He wrote that the susliks "moved about like drunkards." Incidentally Zabolotny described his *tarbagan* in just the same way: "moved about staggering with a drunken gait." How strangely these phrases coincide!

He thought for a moment, then said again:

"What a significant coincidence!"

Very early in the morning, the body of a dead patient was brought in. Deminsky performed the autopsy and Zabaluyev held the kerosene lamp, to give him light.

They worked in silence, without masks. They breathed through their nostrils as they had accustomed themselves to do over many long years, drawing the air in slowly and regularly. Deminsky recalled Klodnitsky's words: "The plague specialist must never worry; when you sigh deeply, you inspire death."

Deminsky turned round and pointed to the lamp. Zabaluyev understood that it was already daylight and the lamp could be extinguished.

When the autopsy was finished and the slides prepared, Deminsky sat down at the microscope. Almost immediately he made way for Zabaluyev. The swab taken from the spleen was full of plague microbes.

Now, again, he was side by side with the disease, he could reach it with his hand. How many times had he been face to face with it since the day when he first encountered it at the burial ground, so well remembered.

All day Deminsky worked to get the laboratory in order. He kept a close eye, in particular, on the work being done on the isolation cages for the experimental animals. From time to time he urged the carpenters to hurry.

Towards evening, they went out of doors.

"You'll apparently be here a long time," said Zabaluyev. "Who knows how long this plague outbreak will drag on. You must take greater precautions, otherwise, in this sort of work..."

"Are you insisting that I wait until they send masks, sterilized clothing and the like?" interjected Deminsky. "How long would we wait, how many days, weeks? King Plague can be conquered and we shall conquer him. But King Stupidity... Oh, no! I prefer to get to grips with the disease now, face to face. So much time has been lost already that I grudge every minute."

The following evening Deminsky said good-bye to Zabaluyev, who was travelling on to Saratov to make his report.

Deminsky was left alone.

He caught susliks, field mice and jerboas in the most varied districts to be found in the steppe round Rakhinka. He dissected hundreds of rodents that appeared to be diseased, yet obtained no clear results. "The suspect cultures I have obtained from susliks continue to remain suspect," he wrote to Klodnitsky. "There are good chains, clear polarity, but the virulence is feeble. The mice die only when there is infection in the peritoneum. Two very diseased guinea pigs should be dead today or tomorrow. I don't know what will come of it...."

The guinea pigs, indeed, died but this time, too, bacterial tests gave no proof of plague: the picture in the microscopic field of vision could be interpreted in a number of different ways.

It was then that he completely changed his method of investigation: instead of killing suspect susliks caught in the steppe, he waited for them to die naturally. Thus, he gave any plague microbes, that might be in the blood of the animals, an opportunity of spreading, gaining a strong grip on the organism and penetrating to the blood, where they could be discovered more easily. He made the dissection only when the rodent had died a natural death, and immediately after the death, whether it occurred in the day-time or at night. But even with his new method he failed to find plague microbes in the bodies of the susliks; it was not possible, therefore, to prove that the animals were dying of plague and not of some other disease. But Deminsky did not despair; after all, nature carries out her experiment on thousands of millions of specimens, killing perhaps one suslik in a thousand or a million. One could not rely on an accidental find, or a piece of good luck; one had to rely on the omnipotence of persistent, tireless, human toil.

Toil filled every hour of Deminsky's life in Rakhinka.

In a letter home, he wrote: "There's only one thing I regret and that is, that I haven't got twenty hands." The letter travelled to Astrakhan, carrying with it to the distant town the faint smell of disinfectant.

That same day the second pair of hands arrived in the shape of a tall, stooping young woman with myopic grey eyes. Before she could introduce herself, Deminsky made a show of his displeasure.

"This isn't work for women, my dear," he said. "You just go straight back; it will be better that way!"

The woman showed no sign of having heard the words and introduced herself:

"Elena Merkuryevna Krasilnikova. You probably think I'll be a nuisance, but I'm quite used to this sort of thing."

"To plague?"

"Oh, everything in general. I'm used to work."

She looked round, then calmly sat down on a chair. She evidently wanted to banish any more doubts he might have, for she added:

"Last year I went to Persia on a schooner as a *feldsher*. Cholera broke out on the ship, but all the same I managed."

Elena Krasilnikova remained in Rakhinka. Would he ever have done all the work that piled up, without this second pair of strong, steady, skilful hands, without this quiet young woman with the clear head and self-sacrificing nature? Dissections, dozens of animals under experiment, trips to villages to visit the sick, the constant lookout for epidemics among the animals in the steppe.

Usually they returned home together. They would change their clothes and disinfect hands and face. Deminsky would take a chair opposite Krasilnikova, and ask her questions.

"You've been sailing on a schooner, now you're working on an epidemic. Just tell me, couldn't you have found work of a more peaceful nature?"

She told her story in a few words.

"Last year my father went quite blind. During the winter months, I study in Moscow at the women's medical courses, but in the summer I have to earn something at least, to keep him and myself alive."

"But is it so hard to find other work?"

"What's wrong with this work?" asked the girl, with a shrug of her shoulders. "It has to be done."

She hurried to change the subject.

By September, the epidemic was quelled. Immediately, with the usual speed the Astrakhan authorities showed at such times, the instructions arrived to close down the laboratory.

Deminsky refused to carry out the order. He had no results to show and there were forty-two susliks under experiment; among them were animals showing very suspicious clinical symptoms. Most important of all was the fact that although for a whole month there had been no new cases of disease among the people, the outbreak of disease among the steppe animals continued.

He wrote to Astrakhan informing the authorities that it was not a matter of closing down the laboratory, but of developing bacteriological investigations as widely as possible. The long, ardent letter ended with the request:

"Send an experienced assistant. There is so much work to be done now, that it is inconceivable that only two people can cope with it."

Confirmation again came from Astrakhan that the situation in the province was satisfactory as regards plague and, consequently, it was not expedient to continue bacteriological research. By way of additional confirmation, it was reported that funds had been stopped.

Deminsky put the letter aside. Through the window he could see the cows, raising clouds of dust, lumbering home from the steppe. The hot, red sun was sinking behind the roofs of the houses.

"Each to his home!" said Deminsky. "Our orders are the same: 'each to his home.' You know, Elena Merkuryevna, you should really pack your things and take the road, for they declare they won't send money to keep the laboratory going. They're such determined people, there!"

"Are you leaving, too?" asked Krasilnikova.

He stepped over to her, and only when he spoke with an unusually high note in his voice did she realize how agitated he was.

"I refuse to go! They can do what they like! I'd be a criminal if I went, worse than a criminal, because indifference is always worse than evil. You saw the rodents dying out there in the steppe yesterday. There have been no cases of death among the people for thirty days, but in this province, which is pronounced safe as regards plague, there is still an undeciphered, unstudied, unsolved outbreak of disease among the steppe animals. Maybe they don't want to notice it, there. But here, one would have to be a criminal to go away without discovering anything, without finishing the work!"

"And you think I'm some sort of criminal? I'm going to stay here as well!" she replied stoutly.

He did not argue with her; deep down he felt sincerely glad that she had taken this decision.

"A thousand thanks!" he said, as he shook hands with her. "I can't imagine how, without you, I. . ."

The work went on at fever heat, day and night.

The seventeenth suslik died during the night. Deminsky was on his way to the laboratory to dissect the animal. It was nearly morning and there was a narrow strip of light low down to the sky-line, at the end of the street. He walked rapidly, his head bent, looking neither to the right nor the left. He was particularly interested in this, the seventeenth animal: the severe and rapid development of the disease promised interesting results.

As he made the dissection, Deminsky forced himself to use slow and calculated movements.

He bent over, as he studied the surface of the organs, distorted by characteristic swellings. There were the signs of concentrations of microbes which had inundated the lymphatic nodes and broken through all barriers into the rodent's blood. It looked very much like plague!

Very much like it!

He bent over, myopically examining the whole picture and making a mental note of every detail. His heart beat so wildly that he was compelled to take a deep breath of air. In a split second, he straightened his back with a jerky movement.

It was certainly like plague. It seemed that he had at last found what he was seeking.

He made cultures on agar-agar and prepared a slide. It was getting light outside. He sat down at the microscope, fixed a faint ray of light in the mirror, slowly adjusted the lens and began to watch. Under the high power lens, groups of erithrocytes, fantastic outlines of lymphocytes and torn muscle fibres swam into view. Another turn of the fine adjustment and a group of fuchsin-stained microbe bodies, with light poles at each end, floated out of the darkness.

He watched intently for so long that his eyes began to ache.

This was surely plague, floating in out of the darkness. Plague or something indistinguishable from it.

There, on the spot, in the laboratory, he wrote a letter to his elder daughter in St. Petersburg:

"I've something nice to tell you. I've succeeded in getting a plague culture from a suslik we caught in the steppe for experimental work. And so, the problem as to whether steppe rodents, at any rate susliks, are infected with plague and are probably the carriers of plague, has been solved, with a positive answer.

"Berdnikov, who is working in another laboratory some fifty miles from here, has found a similar plague-stricken suslik."

* * *

From the two ends of the continent, from Manchuria and from the Caspian Sea, disease eternally threatened Russia. From these places it broke through sometimes in the form of terrible epidemics like that at Vetlyanka and sometimes as small but dangerous outbreaks.

Preparations were then started to abolish all possibility of plague storms occurring.

Zabolotny's proofs in Manchuria had been confirmed in the Caspian area, in connection with another species of animal.

"Plague is not a disease of man," boldly proclaimed Russian science, "plague is a disease of rats, susliks and *tarbagans*. Only in the world of rodents, which are the most numerous section of mammals, have microbes all the conditions necessary for permanent existence. It is only by accident that the plague microbe gets into the human environment. No matter how dangerous epidemics among people may be, they are only the blind alleys, the beginning of which is always to be found in the earth, in the underground habitations of the rodents. These are plague's crown possessions. It is there that the decisive battle will take place and there alone that genuine victory, not just apparent, transient victory, can be won."

Deminsky paced from one corner of the laboratory to the other, his elbows, as always, pressed close to his sides, his hands, which were waiting to be disinfected, cautiously held away from him. There on the table by the window lay the plague microbes, under the high-power lens. Plague had been discovered in the dead body of a suslik found between Perevoznikov and Romanenko villages, the danger zone where there had twice been epidemic outbreaks. Thus, the thing which many scientists had foretold or sensed, but which no one had so far seen, though concerning which there had been constant arguments for decades, the thing on which depended the fate of all the work to eradicate plague in the Astrakhan steppe —this thing had now, at last, been found.

The microscope drew Deminsky like a magnet. Only a little time had passed but he was already anxious to open the thermostat and see how the cultures were growing on the agar-agar. In a few days' time, the cultures on the medium would be ready. They would be taken and injected into experimental animals and would then show whether plague was present or not, whether genuine victory had been won or only apparent victory. The eye is deceptive, but experiments on animals are not.

At last Deminsky heard someone knocking at the door.

"Is that you, Elena Merkuryevna? Why so early?"

He looked through the window and could not help smiling: it was already almost midday, the sun was high overhead, pale and forlorn in the cold autumn sky.

"Breakfast? I'll just change. You think my voice is strange? Why? There's nothing wrong, my dear Elena. Everything's going splendidly."

He breakfasted, returned to the laboratory and worked till evening.

At last he put away microscope and slides and went out. Over the clouds, like a swift bark diving in and out of the clouds, rode the moon in a ring of silver which pointed to a change in the weather. In the street all was silent, the rows of houses were dark. Even the dogs were quiet. The entire world at that hour seemed to be riding fast with the moon towards some unknown goal. Rakhinka alone was stationary.

The air was fresh and cooling to the lungs.

Not many hours would pass and then the cultures on the agar-agar would have grown and the experiments could be made which would give the final solution to the problem of the nature and destinies of Astrakhan plague.

The experiment was proceeding and required no interference by the investigating scientist. Deminsky tried to devote his thoughts to something different. He had not been fair to his own folk, he must now alter all that. Perhaps he could ask for leave and take his wife and children to St. Petersburg, to see the plague fort? But why the plague fort? They could just rest somewhere, roam about the city, listen to Chaikovsky's music.

Towards morning Deminsky dozed. When he awoke he felt very unwell. "It's anxiety and insomnia," he thought. "I must take myself in hand or I'll be put right out of the running." He felt physically weak; he had no appetite, nor did he want to move.

By midday he felt pain in the chest. With the pain came the thought: was he infected?

By evening, Deminsky had no doubt at all that he was ill and he knew the cause.

He shut Krasilnikova out of the room and spoke to her through the closed door:

"I'm afraid I'm here now for good, Elena Merkuryevna. I don't want to risk your life, nor have I the right to!"

On the morning of October 5, a reddish sputum appeared. Deminsky made a great effort and dragged himself to the laboratory. There he made slides, looked at them through the lens and saw the familiar picture in the frothy, bloody foam: pneumonic plague!

His first and last thought, in the seconds during which all doubts vanished, was that the time left to him must be put to good use, nothing must be forgotten. Most important of all, the experiment must at all cost be recorded. It was terrible to think that he might become unconscious and so lose the last hours. Yet, besides Krasilnikova, there seemed to be no one available in the steppe. He wrote a telegram to Klodnitsky at Zavetnoye village.

"I've contracted pneumonic plague from the susliks. Come over. Take the cultures that have been produced. The notes are all in order; the laboratory will tell you the rest. Make an autopsy of my body and regard my case as experimental infection of a human being by suslik.

"Farewell, Deminsky."

But suppose Klodnitsky had moved from Zavetnoye and the telegram failed to reach him?

He sent the sputum to Romanenko village, where Berdnikov was working.

"I think I've remembered everything," he thought to himself.

He had finished the work, and so began a letter to his wife. He wrote that he had fallen sick, had injected serum, but doubted whether it would save him. "So far serum does not help much against plague; the treatment of pneumonic plague is also a matter for the future, though not the very distant future, it is to be believed."

He wrote that it was sad and annoying to have to quit life at this juncture, but that his death would not be in vain. "I have had the good fortune at last to see plague among susliks." The words "I have had the good fortune" sounded strange, but he did not strike them out. Had this not been the greatest and the last fortunate event in his life?

"If only I could be sure Klodnitsky would arrive in time to save the cultures, to finish off the work, to see what I shall now never see!"

He wrote that it was very hard to think of what would happen to his family: "I have always thought I had many more years to live and that I would be able to see my daughters safely on the path of life, and make you happy. It has turned out differently."

He finished his letter, safely locked the door from the inside and lay down on the bed. He awoke to the sound of light footsteps; Elena Krasilnikova was moving quietly about the room. In spite of his request and the fact that he had strictly forbidden her to do so, she had somehow contrived to open the door.

When she saw Deminsky had opened his eyes, Elena Merkuryevna said in her usual slow, unruffled way:

"Don't drive me away, Ippolite Alexandrovich, for all the same I won't go! And don't worry. You see!"—she pointed to her mouth protected by a hand-made mask of several folds of gauze. "I have sent the telegram and letter. I disinfected them, as you said, and posted them."

Deminsky kept a close eye on the course of the disease. He watched himself as he would have studied a patient, carefully weighing the symptoms, as a doctor would have done, so as to be able to follow the state of the organism.

For a few minutes there was some improvement. Deminsky covered his mouth with a piece of gauze, turned to the wall to minimize the chance of passing on infection, and spoke to Krasilnikova.

"I think the disease is developing a little differently... not quite in the usual way." He felt so weak that he had to pause between the words, as he lay with his eyes closed.

"You know, Elena Merkuryevna, I've been thinking all this time that while the plague microbe inhabits the suslik, it has one kind of power, one kind of features, and that only by changing its living environment, by passing several times through the human organism, does it change and acquire the usual virulence known to us."

Deminsky was lying with his eyes open, talking more rapidly and almost without a pause, his voice distinct and steady.

"I mention this because I have been thinking on these lines for many years and probably won't be able to verify it myself; I would very much like you or Klodnitsky, or someone else to take over this work. When I was investigating cholera vibrio in the estuaries, at different times of the year, I discovered that the virulence, and even the form, of the microbes change according to the conditions of life, and now..."

He coughed and looked at the handkerchief stained crimson by the sputum.

"Incidentally, it is possible that microbes passing from the suslik to the man are weaker than usual," he said, "but all the same they are evidently virulent enough."

He closed his eyes again and lay so motionless and quiet for several minutes, that Krasilnikova imagined he was sleeping. But he opened his eyes and said:

"Serge Korzhinsky and I dreamed of curing the steppe of plague and droughts and sandstorms. So far, Serge has died of tuberculosis, and I... It is all much more difficult than it seems, but it is all possible, Elena Merkuryevna."

For a few seconds, he rested again.

"If you are ever at Baskunchak," he said, "look out for some young oaks we planted ... they should have grown by now ... make a point of looking at them."

The improvement was only temporary and there was soon a change for the worse. By evening the patient had lost consciousness.

Less than twenty-four hours after Deminsky's death the cultures which Dr. Berdnikov had prepared from the sputum Deminsky had sent him, produced a growth of characteristic plague colonies. The autopsy, and subsequent experiments with cultures, confirmed the conclusions of the scientist: susliks are the chief plague-carriers in the Astrakhan steppes just as *tarbagans* are in Manchuria.

Deminsky's discovery marked a new stage in the struggle between Russian science and plague. The disease had now become visible in the Caspian area too. Western scientists attending the International Plague Conference in Manchuria had denied and ridiculed the truth of Zabolotny's ideas. These scientists were now clearly defeated. It had been shown that *tarbagans* store and carry plague on the vast territories of Asia, susliks in the Caspian area, mice in Egypt and East Africa and rats in the ports of India and Europe. The front of struggle against plague epidemics was not merely plotted on the map, but was laid bare along the whole of its length.

Zabolotny's discovery can be regarded as the first victory for Russian anti-plague science; Deminsky's was the second. From now on the way was opened up for destroying plague in its natural environment.

WHAT COULD BE AND WHAT IS

THE CONQUEST OF A CONTINENT

In the selfless labour of one generation of scientists after another, the school of Mechnikov, Gamaleya, Zabolotny and Pavlovsky, the new trend of Russian research workers in the science of combating dangerous diseases triumphed. Perhaps the shortest and most exact description of this trend would be "offensive prophylaxis."

Academician Skryabin writes that modern medicine uses two different methods to combat diseases: attack and defence. The aim of offensive prophylaxis is "the physical destruction of the causative organisms of disease at all stages of the living cycle and with every available method of mechanical, chemical or biological action." It is not an accident that these words, taken from a scientific article, are so reminiscent of an army order of the day: the aim, which is the destruction of the enemy, determines the method.

It is very simple to kill a microbe in a test-tube; it is a million times more complicated to destroy it in the living organism. How infinitely greater, apparently, is the task of finding, and then preventing the spread of, a hostile microbe not in the test-tube, not in an organism, but in the infinite combinations of living and non-living that goes by the name of nature.

The road selected by Russian science was both dangerous and complicated. Observations and experiments developed into "experiments on oneself." The scientist encountered a whole family of sciences. The bacteriologist became a geographer, a botanist, a soil expert.

This was the road to the very heart, to the most secret places of nature.

It has been calculated that even in the Volga drought area every gram of soil contains two thousand million microorganisms. This means that one gram of soil contains something in the nature of a whole world population of microbes.

Evidently these microbes—tiny, simply organized lumps of living matter playing such a colossal role in nature—are much older not only than mankind but every other living thing we see on earth. Probably they originally only lived in air, water and earth. But the world became more complicated: in the process of evolution, highly-organized species of plants and animals, ever more complicated, made their appearance. Microbes penetrated into the blood of animals from out of the earth, air and water; they were urged on by the irresistible force of reproduction, they were obedient to the desire of everything living to increase its area of habitation. Multitudes of microorganisms perished, but what is any loss to an army whose numbers run to infinity. Together with air, food and water, new bacteria penetrated into the blood through the lungs and the pores of the skin.

On the one side were the defence forces of the animal organism, on the other, the variability and incalculable fecundity of the microbe.

Numerous species of bacteria were destroyed in the struggle for existence before there appeared the variety which could live in the dark, warm blood stream.

Probably it was in this way that there originated those varieties of pathogenic microbes which live as parasites at the expense of their hosts, which sap their strength and sometimes take their life.

Some species of animals died out, taking with them the microbes which had adapted themselves to life in the blood of this species of animal. Diseases appeared and vanished. The variability of the species which were susceptible to attack by bacteria and were gradually perfecting their defence forces came into competition with the variability of the attacking microbes. The bacteria used ever more tortuous paths in order to win the battle of adaptation to the environment.

What infinite numbers of years had to pass before nature, working blindly and using two levers—mutation under the influence of environment and selection—succeeded in creating such a flexible weapon of destruction as plague!

After wiping out one species, the plague microbes found their way to others. And finally, after adapting themselves ideally to the rodents, they spread over almost the entire world.

Microbes, carried by rats, crossed oceans and obtained footholds in port towns. Carried by *tarbagans* and susliks, they settled down on the plateaux, and in the steppes of Asia and East Europe. Carried by mice, they took possession of wide expanses in Africa.

Throughout all continents. From rodents to man.

So it continued until, to the old defence forces of the human organism which the microbe had "learned" to overcome, there was added something new: the rational mind of the research worker and the courage of the scientist.

Scientists traced the causes of plague to the centre of the flexible, complicated web, where it has its links with nature, and their aim was to break these links.

But the bacteria found they had new opportunities of spreading. Even in ancient times there were cases when the barbarians besieging a town catapulted the bodies of dead animals over the walls of fortresses, in order to pollute the air and cause outbreaks of disease among the besieged. And already in those days the voice of mankind was raised against such methods of warfare. "War is conducted with weapons, not with poisons," said the Roman jurists. "It is unseemly to kill the enemy with poison," wrote Hugo Grotius in his book *De jure belli et pacis*, written in the beginning of the seventeenth century.

The first indirect proof of the possibility that exploiting circles might regard disease as an ally in the struggle against the oppressed can be found in the pages of the history of the Palmares Republic, which ceased to exist when not a single living being was left alive on its territory. The Republic originated on the east coast of Brazil, formed of kilambos—settlements of Negro slaves who had fled from their señors into the depths of the tropical forests. It was founded in 1650 and for many long years the soldiers of the Republic defended the freedom of the little people against Dutch mercenaries, superior in numbers and excellently armed. When it became obvious that the people could not be conquered in open battle because a single soldier of the free Republic fought better than ten Dutch hirelings, de Sousa, the Governor, decided to resort to new methods of warfare.

"They fled from famine and disease, they must be annihilated by famine and disease," he said.

The Republic gave shelter to every slave who sought justice. De Sousa found hundreds of people suffering from smallpox and drove them into the tropical undergrowth, and they carried the infection into the Republican settlements. Disease invaded the homes. To save the healthy from death, the Republican leaders were forced temporarily to withdraw the population deeper into the forest. Governor de Sousa's detachments made use of this opportunity to burn down the homes and crops.

In the middle of the seventeenth century famine and disease were used for the first time as a weapon of offensive warfare. In the eighteenth century the Americans used smallpox to combat insurgent Red Indian tribes. A century later Malthus, the Englishman, "typical for his profound baseness of thought," as Marx wrote, provided reasons for the need to spread epidemic and famine for the benefit of the world. Governor de Sousa and the American General Amherst were the first to use the bacterial weapon; Malthus the parson was the first to bless it.

After Amherst and Malthus, it was not possible any longer to talk about one common front uniting all mankind in the struggle against disease. There was now a breach in the offensive front; unprotected expanses lay wide open to bacteria.

THE FATE OF DR. KELLOGG

That Dr. Kellogg had a brilliant future before him was obvious even in his student years. He was an extremely talented therapeutist, capable of "sensing" the nature of a disease from the earliest days, before the symptoms were yet defined.

He was tall and broad-shouldered, had a sun-tanned face and steady eyes that seldom smiled; he possessed all the attributes to inspire confidence in the patient and, what is less common, he never betrayed that confidence.

Kellogg had a stroke of good luck for, after passing his examinations brilliantly, he was given an opportunity of making a selection from several vacancies. He asked his professor of bacteriology, a man whom he respected more than anyone else, to help him to make his choice.

"In the States, one is rather like a carcass on a hook in the slaughter-house," said the professor. "It has no choice as to what it's to be: ham, sausages, tinned mutton and peas. But since you have a choice before you..."

He paused for a moment and then, without the shadow of a smile, said very seriously:

"It all depends on what you mean to do with your life: to cure fat people of obesity, which is profitable and comparatively simple, or the starving sufferers from tuberculosis, which is most unprofitable and, in the long run, an almost hopeless task. Much depends on your decision."

"I want real medical work," replied Kellogg.

The professor stood by the writing desk. The reply made him turn and look closely at the young doctor, as though anticipating some further, perhaps mute, confirmation of the fact that Kellogg had indeed finally made up his mind. The steady, firm expression in the grey, unsmiling eyes evidently satisfied the professor, for he took the paper offered him, with the list of vacancies, and began to think.

"If that's so," he said at last, "then best of all will be for you to work as a general practitioner in San Francisco. It's miserable pay, but you'll find real medical work there."

The professor went to the book-case. He searched for a long time till he discovered an atlas, so dingy and tattered that it seemed he must have kept it since his schooldays. He opened it and pointed to San Francisco with his pencil.

"What does this city remind you of, colleague?" he asked.

Numerous black and red lines indicating the regular routes of passenger and mercantile vessels crossed the Pacific and met in San Francisco Bay.

"A spider in its web," replied Kellogg, without hesitation.

"Just so," agreed the professor. "Actually I would use another comparison, too. It's like strings, stretching to all the corners of the earth, and that means to all the centres of disease to be found on the globe. It's a sort of Aeolian harp of disease—sooner or later it resounds to every epidemic. And this," he went on, moving the pencil from the blue surface of the ocean and making a lightly pencilled circle round the city, "this is something in the nature of a sound-box of epidemics which, given certain conditions, could so augment the sound that the whole of America would hear it."

Dr. Kellogg had reason to remember these parting words. Several years later he came to see the truth of the professor's comparison.

In San Francisco, the young doctor was given work in the most difficult district, which included almost the whole of the Chinese quarter. There, hundreds of thousands of poor people were crowded in cellars, hovels and dilapidated houses. There was not even time enough to make the simple round of the patients.

Kellogg was a sociable fellow, who could not bear solitude, and he tried to form at least a small circle of friends from among his professional colleagues. But he found this impossible: for some of these people the Chinese quarter was, as it were, beyond the frontiers of the United States, and a doctor who gave treatment to the people of the Chinese quarter could not be regarded as one hundred per cent American; for the rest, he never achieved more than a purely professional relationship even with those of his colleagues who took a broader view of life.

"I don't make enough money for all this talk about dollars, and these people have no other subject of conversation," Kellogg complained to Dr. Kinyoun, his only friend, who was physician at the Naval Hospital and also quarantine inspector on Angel Island.

"Then you must earn more dollars or do without friends," replied Kinyoun.

Actually there was no time to feel lonely. Springtime for Kellogg chiefly signified a sharp rise in the number of lung infections, summer-time—a hopeless battle against the catastrophic increase in cholera and dysentery cases, autumn—the usual aggravation of lung processes in tuberculosis patients: sudden rises in temperature and haemoptysis.

Kellogg only rested when he managed to find a few hours and get away to Angel Island. There, Kinyoun had his own laboratory, experimental animals, microscope, fine bacteriological apparatus, plenty of books and periodicals. There Kellogg felt the atmosphere of his old student days. He wanted to ask hundreds of questions, to go through the new periodicals, to see the bacteriological slides, so excellently fixed and stained, and to do all of it simultaneously.

"You've been longing for all this?" asked Kinyoun.

"Very much," replied Kellogg, making a rapid survey of the laboratory fittings. "You know, I'm finding serious gaps in my education. I was never taught how to treat people without medicines, without vaccines, without air, even. It's so stifling in those hovels that it would even kill healthy people."

"It's still not too late to find another job," said Kinyoun.

"But this is real medical work," Kellogg interjected curtly. "I wouldn't give it up for anything. I always dreamed of this sort of work."

"Dreamed of treating people without medicines?"

"No," said Kellogg, "I dreamed of treating people who would otherwise die, and not of curing fat people of obesity. The latter is not in my line."

In June 1900, while making his usual round of visits, he found in a broken-down wooden hut the body of an old Chinese, lying on a heap of rags in a dark room. The sick man had evidently died only a few hours previously. The first thing that struck Kellogg as he examined the body was the femoral swelling. He immediately suspected plague, although until then there had been no cases of plague on United States territory. Kellogg made cultures of the microbes and slides from swabs, warned the neighbours of the danger, and set off for Angel Island.

Kellogg told his story to Kinyoun. The expression on Kinyoun's face, usually a blend of ridicule and indifference, immediately revealed his concern. He worked rapidly, fixing and staining the slides; it was delightful to watch the precision and economy with which his hands moved, as he fixed and stained the slide.

Kinyoun at last put the slide under the microscope, put his eye to the eyepiece, regulated the light, then silently made way for Kellogg. In the field of vision lay a colony of bipolar rods—plague bacteria.

"I'll inject the cultures into guinea pigs as a control experiment," said Kinyoun, "but of course the city is in serious danger and prophylactic measures must be taken at once."

They sat together at the desk and Kellogg outlined a "plan of defence": quarantine had to be organized, there must be bacteriological investigation of rats for plague infection, and increased medical observation of the population.

On his return to the city, Kellogg immediately informed Dr. Jervis, an official of the city health department, of what had occurred. The man recoiled from Kellogg, his arms raised in an instinctive movement of defence, as though he himself was in direct danger.

"But perhaps you are mistaken, Dr. Kellogg," he asked, lowering his voice to a whisper. "You understand what this means, plague in San Francisco?"

"Unfortunately, I am not mistaken," Kellogg replied, dryly.

Jervis did not pick up the sheet of paper with the plan of defence written on it, but left it lying on the table, put on his spectacles and bent over slightly to read the lines Kellogg had written on Angel Island.

As he read he said over and over again:

"Plague in 'Frisco, you understand what that means?!"

Without changing the tone of his voice and speaking in the same horrified whisper he concluded:

"Several thousand dollars will be needed for your infernal plague. Where can we get the money?"

"I think the circumstances justify the expenditure not of thousands but, if necessary, millions on what you call 'my' plague. You're a doctor, and you understand that if we don't localize the infection in the one small district where it has broken out, and destroy it there, plague can spread to the whole town and beyond it."

"Plague in 'Frisco . . . several thousand dollars," muttered Jervis.

The same evening, without waiting for the decision for funds to be allocated for organizing quarantine and increasing medical surveillance, Kellogg moved to that part of the Chinese quarter which was closest to the plague outbreak.

In the tiny room he had rented in a huge overcrowded house, Kellogg spent the night reading through the literature on plague which Kinyoun had hunted out for him: brief reports in periodicals of investigations by Zabolotny, Khavkin, Yersin, Minkh, Kitazato and other plague specialists. It was clear from Grigory Minkh's work that an outbreak of bubonic plague can develop into an epidemic of pulmonary plague, with its one hundred per cent toll of death. This danger had to be averted at all costs. A few years previously Daniel Zabolotny had made a journey of two thousand kilometres from Trans-Baikal over the Yablonovy Range, through the Gobi Desert, from Inner Mongolia to Peking and from there to the Khingan Mountains. He had investigated many plague spots and had come to the conclusion that the origin and existence of plague infection is linked with wild rodents. This meant it was necessary to remember that if plague infection was passed on to places where wild rodents lived in nature, then it could become widespread and settle and remain there for many long years.

When a messenger arrived from Jervis the following morning, Kellogg was still sitting at the table.

"I thought I'd never find you, doctor," said the messenger. "Mr. Jervis asks you to come immediately."

As soon as Jervis caught sight of Kellogg, he recoiled again to a far corner as on the first occasion, and only when he had taken up a safe position behind a huge desk did he open the conversation.

"I trust you have said nothing to anybody about it?" he said.

"I take it you are referring to the plague outbreak in our city?"

"You presumably understand that no one must know about it."

Jervis was obviously avoiding the word "plague," preferring the impersonal "it."

"I have informed all the neighbours of the case of plague and have notified Dr. Kinyoun. I cannot wait until the epidemic spreads. If you do not wish to help, the population must be prepared to defend itself."

"It's a pity you have overstepped your official duties and revealed a medical secret," interrupted Jervis. "Go and see the Governor, he's expecting you. You can get yourself out of the mess. I don't intend answering for you."

In the Governor's office, there were two unfamiliar people, as well as the Governor. One of them was lean and had bags under his eyes and the bloated face of a man suffering from heart trouble or kidneys; the other was fat with a brick-red neck and the flattened nose of the boxer.

"What have you to say?" demanded the Governor stiffly, without even greeting the doctor.

Kellogg gave the details of what had occurred and proceeded to enumerate the most important of the measures required for combating the infection.

"First of all, we need funds to organize anti-plague measures and, secondly, the population must be widely informed of the danger threatening the city, for everyone must understand the need to consult a doctor on the slightest suspicion of disease."

The lean man with the bloated face listened with his eyes half-closed and his body thrown back into the armchair; the other, with the flattened nose, devoted himself wholly to the occupation of zealously chewing gum.

"There's not a cent in the budget for you, Dr. Kellogg," said the Governor, "but Mr. Harold Chase has agreed to put two thousand dollars at your disposal, out of his own pocket."

"Fifteen hundred," softly corrected the man with the bloated face, without bothering to open his half-closed eyes.

"That wouldn't buy the most essential things," objected Kellogg.

"It'll have to be enough," interrupted the Governor. "And I have to inform you that Mr. Chase is putting this money at your disposal provided that you adhere strictly to one condition: you must be silent, Dr. Kellogg. There are bad rumours in the city and everything has to be done to refute them."

"Precisely," confirmed the man with the flattened nose. "Yesterday twenty of my tourists suddenly demanded to have their bills, weighed anchor and set sail for Marseilles. I advise you to forget the word 'plague,' Mr..."

"Kellogg," prompted the Governor.

"Forget the word, Dr. Kellogg, and never remember it again. Mr. Chase, myself and all the others have no intention of losing money because some infernal Chinese has died and because you can't hold your tongue."

Kellogg took a step forward, his fists clenched; he could scarcely contain himself. But he recovered, and replied coldly:

"A doctor's duty is to inform the population honestly of the state of affairs and I think I am strong enough to do my duty. The epidemic is already here and without the help of the townsfolk I can't cope with it. But I have no right to take money on the conditions you propose."

The gentleman with the flattened nose stopped chewing gum: the man with the bloated face shifted slightly in the armchair and opened his eyes.

"You intend fighting us?" he asked.

"I intend fighting plague, Mr. Chase," replied Kellogg.

"I am not concerned with your plans," interrupted Chase. "I only advise you to bear in mind that people can be taught to hold their tongues. It's all a matter of the method used."

Kellogg left the Governor's office and hurried to get back to his patients. It was now clear that he could count on no help save what he might get from the population; all the more reason, therefore, to make full use of every second.

Halfway home, the doctor turned sharply and almost ran back to the centre of the city. The idea had struck him that he should immediately get the newspapers to publish the news that there was plague in the city. He should do it at once, before Chase had time to influence the editors.

Kellogg knew little of the newspaper world and hardly ever read the city publications, but remembering that Kinyoun had once carelessly remarked of the *San Francisco Review*: 'The dirty rag is perhaps cleaner than all the others,' he decided to call in at the editorial offices of the *Review.*

The editor received him and listened to what he had to say. Kellogg was so eager to have allies and restore his own confidence in the human race, which had been so cruelly shaken by his recent conversation in the Governor's office, that even the restrained politeness of the editor pleased him and seemed to augur well.

The editor left the room for a moment and returned with a heavily pomaded, pink-cheeked, round-faced fellow.

"Mr. Samuel Franklin," the editor introduced him, "one of our staff."

A sickly smell of hair-oil and chypre filled the room. Samuel Franklin laid the tools of his profession on the table: a sheet of paper, sharply pointed pencils. He cocked his head and looked expectantly at the doctor.

"Shall we get down to work?" he suggested.

From the moment the reporter entered the room, a vague, fixed smile settled on his face.

"Just a brief interview," Samuel Franklin explained after a moment's pause.

Kellogg paced the room, trying to select only what was most important from the host of points he felt he should relate, trying to outline what was most important with the maximum brevity.

Samuel Franklin wrote with zeal, his oiled hair glistening dully; every now and then he looked up and his face still carried the same heavy, fixed smile.

Kellogg finished his report on the plague outbreak in the Chinese quarter and went on to explain the extremely great danger of the epidemic spreading further. If an outbreak of disease began among the rats, they would spread plague to the whole of the city. Since Zabolotny had made his investigations there was reason to believe that infection might spread even to rodents out in the countryside. And everyone knew that America, particularly the Western part, had rodents in abundance. In the prairie belt and the desert plateaux there were susliks, marmots, prairie-dogs and mice-like rodents; in the west mountain forests there were squirrels, flying squirrels, beavers, tree porcupines and jumping shrews.

Kellogg dictated slowly, often stopping to give the *Review* staff reporter time to catch up with his notes.

"Thus," continued Kellogg, "in the Chinese quarter of San Francisco the fate is being decided of hundreds or thousands of people who are in direct danger of infection. The other question is whether this plague infection, brought by accident to our continent, is to take root—in which case the struggle against it demands human sacrifices, the expenditure of millions and truly tremendous efforts,—or whether we shall refuse to allow the infection to make a permanent home in our country. What the outcome is to be will depend on us alone, the people of San Francisco. Please see that you get that point in: that everything depends *on us* alone, that is the most important point."

When he finished, Samuel Franklin coolly handed his notes to Kellogg.

"You have to sign them; just a formality," he said.

Dr. Kellogg looked at the sheet of paper covered with evenly-spaced rows of writing. He began to read and was at first totally puzzled; then, as he read on, he had to make a great effort to control himself and conceal his agitation from the oily-headed individual with the stereotyped smile.

The notes began thus: "Absurd plague rumours are being spread about town. A Chinese died of delirium tremens and his neighbours, being in almost the same state as that which cost the dead man his life, pronounced a stupid diagnosis."

"It is not easy to put a humorous slant on such material, but you must admit that the delirium tremens idea is pretty good," said Franklin, with the same fixed smile, as he looked at the doctor. "As for the rest... You must realize we can't print the rest."

Kellogg was neither listening nor reading. He held the sheet of paper before his face to give himself time to cool down and collect his thoughts. If this was the least filthy of all the dirty newspaper rags in San Francisco, as Kinyoun had asserted, then what could be the state of affairs in the other newspaper offices? This was evidently only the beginning of the fight about which Chase had warned him. Was he strong enough to go through with it? He had to be strong enough.

Meanwhile, the epidemic sound-board of the big city operated as was to have been foreseen. Having picked up the infection, it augmented and returned it. Cases of sickness were counted in tens and hundreds now, not units. Plague struck an increasingly wide area. The first plague victims among the rodents were found and investigated in the laboratory. Kellogg and Kinyoun did everything in their power to localize the infection. But they knew only too well that plague had slipped from their grasp and now had a strong foothold in cellars and doss-houses, that it had crawled throughout San Francisco. The *Review* printed Franklin's filthy story and the other newspapers repeated it. Forty-one years later Professor R. H. Creel recalled the events of those days in an article entitled "The Plague Situation in the Western United States":

"The announcement that plague existed in San Francisco was very bad news indeed to the commercial interests of California," wrote Creel. "The publicity obviously would deter tourists and injure business; therefore, the existence of plague was denied by the state administration, all of the San Francisco papers except one, and practically all commercial interests. The campaign was launched by state officials, the San Francisco press, and the most eminent legal talent that Chinese money could buy...."

This restrained testimony from an American scientist, who knows his country well, expresses what is most important. The fact that hundreds and thousands of people were dying did not mean that there was a danger of Californian commercial circles losing money; but any admission of the existence of plague in the city would undoubtedly have meant a sharp decline in profits. Trading circles and their bribed "state officials" unhesitatingly sacrificed national and state interests for the sake of ensuring dividends. The rulers of the state proclaimed war to the death against Dr. Kellogg, they did everything to deprive him of a living, to besmirch the name of a courageous doctor. Only fear of publicity prevented them from making away with the doctor altogether.

Kellogg continued the battle but it could have been foretold that, since to all intents and purposes plague was enjoying state support, it would inevitably be victorious.

And so it was.

Never before had the plague microbe had a home in America. But now the infection accidentally brought by a ship, cruising between Bombay and San Francisco, obtained a foothold at the port, spread throughout California and created plague centres in Puerto and New Orleans, strode over to the north in the direction of Idaho and Washington, moved from West to East, crossing the Colorado River, and continued unhampered until it had gradually covered the distance from the Pacific coast to the Atlantic.

The words "continued unhampered" are really not suitable to the spread of plague epidemic in the United States. On this continent, which was new to the plague microbe, it took its first steps very slowly and uncertainly. It gave people time, as it were, to make preparations and go into battle.

But time was allowed to be lost.

Time was given to the plague microbe which made good use of it to adapt itself. Official American statistics carefully conceal the data concerning the spread of plague in the United States. But news of plague outbreaks spread in spite of these bans. In the autumn of 1946 an article by Gerard Piel in *Life* reported that in California "the population often suffers from plague." Gradually plague infection spread to California, Washington, Nevada, Idaho, Montana, Utah, Arizona, New Mexico and Wyoming. So the microbe made itself a home on a continent that was new to it.

A CONVERSATION IN SMOLNY

Zabolotny first heard the story of Dr. Kellogg while he was still in Mukden. Subsequently he often recalled it.

Events in America, as expressed in Kellogg's struggle against the authorities in the State of California, affected every plague specialist, in some measure. Science was not interfered with so long as the scientist kept to his laboratory and his actions did not involve "business interests."

In the early days of the investigations into the role *tarbagans* played in spreading plague, the press in general was silent about these investigations; but as soon as the fur manufacturers became in the slightest degree suspicious that restrictions might be placed on the hunting of *tarbagans*, war was declared on this scientific research. All the newspapers from Leipzig to Mukden published scornful caricatures, and a wave of filthy, merciless hatred splashed from the news columns over the Russian scientists.

Perhaps the word "unprofitable" was not used outright; more acceptable words were substituted, nevertheless it was this word and no other that determined the fate of scientific discovery. Even after Khavkin made his vaccine, plague continued to exterminate three to four hundred thousand people in India every year; and, it was found that cases of sickness in numerically equal groups of Europeans, Brahmins, and lower caste Indians were in the proportion of 1:23:67. The vaccine protected only people who could afford to pay for it.

We know that there are many blind people in India. Scientists proved that these formerly unexplained epidemics of blindness are due to vitamin deficiency, inadequate supplies of vitally important substances in food. Scientists learnt to produce blindness from vitamin deficiency among experimental animals in laboratories, and also how to prevent it. Yet the number of the blind in India was still great.

A yawning gulf existed between the possibilities afforded by science and the realization of these possibilities. Science has created up-to-date means of combating blindness, has cured hundreds of people, yet millions have been blinded by famine. The doctor sometimes had vaccines and medicines, while the majority of mankind lacked bread. During the recurring droughts in Brazil, from one-third to half the population died in the drought areas; vast territories of India and America, Asia and Africa, Europe and Australia have been in the grip of famine; vaccines did not save people from starvation. And in alliance with famine, microbes became an invincible force.

* * *

Zabolotny welcomed the revolution. Long before October 1917 his life experience had shown him that revolutionary upheaval was necessary and inevitable.

In 1918 life was hard in Petrograd and the newspapers carried bad news: famine, the rising of the Right Socialist Revolutionaries in Tambov, the landing of British troops in Murmansk, Archangel occupied by American and Anglo-French troops. But in spite of it all, never before had people thought so much about the future or felt so confident about it.

When Zabolotny visited Smolny and there outlined his plan to organize anti-cholera work, the deputy from Viborg district asked for the floor.

"A group of the finest doctors will be concentrated in the district," he said. "It is necessary, besides getting rid of cholera, which is a temporary business, for the doctors to make a thorough investigation into the health of the people living in the district, into the possibility of building new hospitals and sanatoria, making new parks. We must think of tomorrow, of the future...."

The room was dimly lit, the filament of the lamps burned with a dull, smoke-red light. It was difficult to distinguish the face of the speaker; his voice was thick and husky and his words were frequently punctuated by a dry cough. As Zabolotny listened, he called to mind Professor Nikolayev. He had formerly been one of the most prosperous doctors in the capital; now he seemed, somehow, to have become flabby, and had allowed a growth of iron-grey hair to cover his chin. In Nikolayev's study there was a porcelain mortar for grinding grain, a flint and steel, and an iron stove. When Zabolotny had approached him to join in the medical work, Nikolayev had said:

"Today we are somewhere between the bronze and stone ages, but we're moving towards the stone age. A big city without heating, without electricity and water supply is a terrible thing. What we should be doing is seeking for caves and learning to hunt for our food in the forests, and to make fire."

The deputy from Viborg district continued, clearly enunciating his words:

"Doctors have to bear in mind that the workers are not willing to put up with the disgraceful idea that they must die young. After winning power, one of our first tasks should be to work to prolong life to its natural limits."

As he returned to his seat, the deputy stopped, to conclude with the following words:

"What Professor Zabolotny has proposed is perfectly correct and sufficient for the moment, but let us recall Pisarev's words which Vladimir Ilyich Lenin loves: man should know how to dream, even 'from time to time to run ahead and contemplate in imagination the complete and finished picture of the creation, which is only beginning to take shape under his hands.' Without the ability to dream it is impossible to work for the revolution and the revolutionary people. But he who, like Lenin, knows how to believe in the people, to feel and express the dreams of the people, will see those dreams come true."

THE REALIZATION OF THE IDEA

THE BEGINNING OF THE OFFENSIVE

This story is separated into two periods—the preparation and the realization; it is separated by the dividing line of October 1917.

In the civil war years, Zabolotny organized epidemiologists for the battle against typhus and spent days and nights in the hospitals. When asked by his friends whether it was not hard almost entirely to abandon science and become engrossed in practical work, he replied with complete assurance.

"Just now the Red Army is deciding whether science is going to live or perish."

Actually Zabolotny never doubted for a moment that science was to live, and not perish, that it was only about to begin to flourish.

In America, Professor McCay published an interesting piece of research work. It ended with the brief conclusion: "The extermination of rodents is desirable from the sanitary point of view, but undesirable from the economic point of view." It was just as though two different people, with the same name but very unlike each other, had been disputing in one and the same article: McCay the businessman was determined and would never entertain the idea that it was possible to curtail supplies of raw materials for the fur industry; McCay the doctor was timid, lacked confidence, but wanted some consideration shown also for the interests of the people and the health of the people.

As though deliberately to quieten the conscience of McCay the doctor, Professor Mayer, his fellow-countryman, declared that the complete elimination of endemics, that is to say, the complete elimination of centres of infection in nature, was impossible.

It was about this time that in the U.S.S.R. Daniel Zabolotny formed the first Chair of Epidemiology and in his first lecture defined quite differently the limits and aims of the young science: epidemiology is the science of the *destruction* of diseases. It was already a matter not only of plague, but of dozens of infections of the most varied kinds. Evgeny Nikanorovich Pavlovsky elaborated his theory that diseases have their natural centres; prophylaxis on the offensive was put on a firm scientific basis, and it became possible to draw up a list of infections which were due to be destroyed within the next few years.

The list included plague, smallpox, cholera, typhus and typhoid, malaria, leprosy, taiga encephalitis, Leishmaniasis, guinea-worm infection and a number of other very dangerous and widespread diseases caused by certain worms called helminths.

In the days when the Soviet troops under Frunze were forcing their way across Perekop, plague specialists, returning from the fronts, were already setting up their line of anti-plague defence. It was built on the basis of a broad state plan. It was calculated that the Land of Soviets and the peoples of neighbouring states should be protected from plague by a system of institutes, laboratories and observation posts. The very first years showed the reliability of the anti-plague line. Centres of infection were cordoned off. The microbe was locked inside the last of its realms and there were no longer even isolated cases of plague among the people on Soviet territory. Plague infection was crossed off the list of active diseases.

In nature, however, plague microbes still continued to exist. So, in order to destroy plague among rodents, in order to wipe it from the face of the earth, in the full sense of the phrase, much more had to be discovered.

The districts where there were outbreaks of disease among animals were surrounded, as it were, by a barrier. The investigating scientists performed their work in the area encircled by this barrier, in places where plague was still alive.

Zoologists also joined in the search. Kalabukhov and Rayevsky, Moscow University students, went out into the steppe with one single assignment: to observe, observe and observe again.

The conclusions would come later; all they had to do at first was to learn and "feel" the steppe at every hour of the day and every month of the year.

The research students made some sort of shelter for themselves. Birds and beasts, in a word, all the inhabitants of this gloomy corner of the steppe, became accustomed to the little hump of ground and the two observers hidden behind it. For hours on end the zoologists lay motionless under their cover, making their observations. The winds blew, the snows melted, and although there were still traces of snow in the hollows, the susliks felt the warm atmosphere and emerged from their burrows; mating began. Three weeks afterwards the young animals made their appearance. They grew rapidly and fifty to sixty days from the end of the hibernation period saw the young susliks dispersing through the steppe, seeking out old burrows, clearing out the litter, repairing underground passages and making homes for themselves.

Kalabukhov kept up his vigil from dawn to sunset. He strained his eyes during the twilight hours to see how the susliks hid in their burrows, how the weasels and polecats stalked their prey. He even tried to see what could not possibly be seen, what could only be deduced from indirect data: how the insects made use of the cool of the night to leave the burrows and crawl over the surface of the earth to meet the rodents.

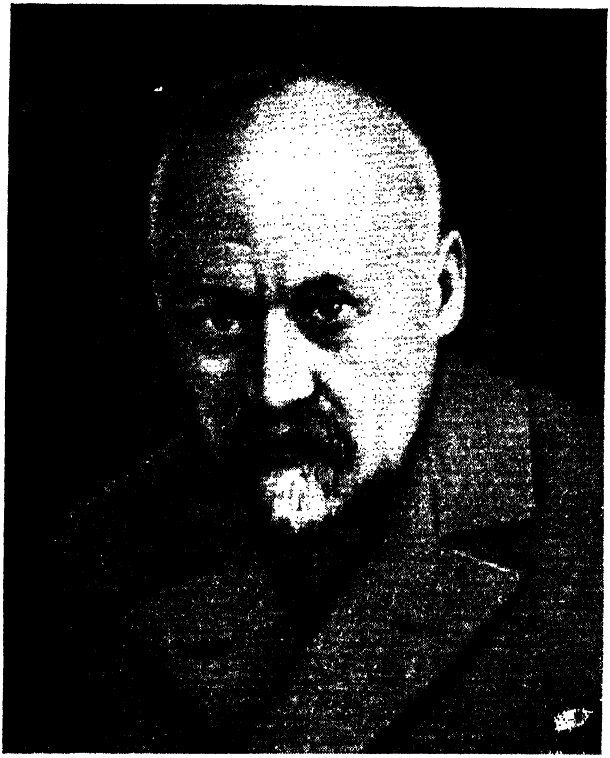
Rayevsky would jokingly declare his colleague knew the name and surname of every suslik in his observation area.

The joke was close to the truth.

The zoologists made an ocular census for their section of the steppe. The number of susliks they counted increased during the period when the young went off to make their own homes; the susliks were most active and mobile at this time, and it was then that plague became noticeable. The susliks began to die in consequence of epizootic disease. The weasels, polecats and birds of prey completed the thinning out of the suslik population. The rodents became fewer and fewer, and when the steppe population dropped below a definite concentration, the epizootic disease disappeared altogether.

Contact was obtained when there was a high concentration of rodents and broke off when the concentration was low. It was not enough for plague that susliks inhabited the steppe, it required that there should be a sufficient number of the animals on a definite area of territory.

The zoologists returned from the steppes tanned by the sun, tired, leaner than before, but happy. Professor Mayer considered impossible the complete destruction of plague in nature, since it is impossible to destroy all the rodents. It was now clear that total extermination was not necessary. All that was required was to assist the polecats, weasels and birds of prey to reduce the maxima of concentration, to destroy part of the rodents and so prevent the circuit of disease closing.



Daniel Kirillovich Zabolotny

Experiments in the steppe confirmed Kalabukhov's observations. It appears that if for several consecutive years the number of susliks is deliberately reduced in a district where previously outbreaks of epizootic diseases recurred year after year, and then interference by man is stopped, then, although there will be an immediate increase in the population of susliks in the steppe and contacts will be restored, outbreaks of epizootic diseases will not be renewed.

The circuit closes, but no energy passes through it: the microbes have disappeared and there is nowhere they can come from.

A large sheet of squared paper is fixed to a wall; on it are two wave-like curves. This graph is the result of several years' observations in a plague centre: the work of plague expressed in mathematically concise form. The watching scientist in the steppe marked off one square kilometre of the steppe for his own observation work. With the advent of spring, he saw the first suslik leave its burrow; then two, five, six other animals followed it. The new generation of rodents was born and the graph, rising by millimetres, crossed the red line. This is the moment when the scientist watches plague break out in his particular area: the first plague-infected animal dies. Under the first curve another appears, which registers the devastation caused by the disease. Influenced by the outbreak of epizootic disease, there are daily fewer susliks and the graph which indicates the number of living animals, slides downwards, first gently and uncertainly, then more and more steeply. The second graph, meanwhile, which counts the number of victims of disease, mounts and reaches the maximum, then drops again and disappears below the red line.

The epizootic disease dies out of itself. There is not enough food for the plague, there are too few rodents and they come together rarely, so that the microbes are unable to pass from the sick suslik to the healthy.

The autumn and winter months pass. The steppe comes to life. The susliks wake up and come to the surface and if, during the preceding years, no war has been waged against the rodents, epizootic disease breaks out again after a short period of time.

Where does it come from? Where does the microbe live during the autumn and winter?

At one time Mechnikov said, when planning his expedition to the Volga steppe:

"We must find out where plague spends the summer months."

The summer "pastures" of the plague microbe had been studied, all that remained to be discovered was how the microbe spends the winter.

After the summer surveillance, winter observations began.

The earth was frozen over. Plague had retired below the red line on the graph. In the steppe it was hidden underground. The soil had to be melted. Camp-fires burned, throwing out red gleams. The armour of ice was broken up with crow-bars. The plague specialists penetrated to the depths of the rodents' underground fortress, divining each ramification, each turn of the dark, narrow passages.

Gaisky opened up burrow after burrow, on an area where there had been a heavy outbreak of epizootic disease during the preceding summer. It appeared that already during the hibernation period 18 per cent of the sleeping susliks had died. Was this perhaps some trace of the winter epizootic disease? The strange thing was, however, that not a sign of the plague microbe could be found in the organs of the dead animals. The scientist, therefore, suggested the idea that when the temperature is low, the plague microbe changes its form of existence, and turns into a filtrable virus, invisible under the microscope.

The future would show whether Gaisky's supposition is correct. In any case, one thing is clear: the microbe, visible or invisible, exists during the winter in the epizootic area. Obviously, it also hides, together with its carrier, under the earth and there, inside the sleeping rodent, changes its properties, exists but does not kill. Otherwise, it would remain there under the earth, after having broken, for all time, the chain of epizootic disease.

But how does the microbe change its properties, where does it hide?

The work of one scientist in one laboratory is continued and tested by his comrade, sometimes hundreds and thousands of miles away, in totally different conditions. Daniel Zabolotny guided this collective work. The Ukrainian Academy of Sciences elected him its president. Zabolotny returned to his home, the place where he had studied and worked as a regimental physician, the place he had left in 1896, in order to go to India, to make the first of an endless series of journeys in the tracks of plague. He stood at the head of the Ukrainian Academy of Sciences, but this did not prevent him from following every step of the work performed by all the units of the numerous, strong army of Soviet plague experts, operating in the Volga regions, in the Trans-Baikal and outside the country.

The winter observation work continued. Experiments were added to this observation of living nature. Gaisky and Churilina injected a lethal dose of plague microbes into a rodent, when it was hibernating. The animal did not die. When the temperature is low, the disease drags on for scores and hundreds of days, the microbe loses its power to kill. It can get into the rodent before the hibernation period and come out of the burrow in the spring-time, together with its carrier.

But so far, no one had seen this important process taking place naturally, in wild nature, without the interference of man.

Grikurov began searching during the days just before spring. Darkened, spongy snow lay over the steppe. The tufts of last year's feather-grass protruded from the snow and bent to the wind. The steppe seemed more deserted than usual. The rodents had to be caught immediately, as soon as they came out of their burrows, otherwise even if plague microbes were found in them, it would not be possible to prove that they had been inside the suslik throughout the winter.

Grikurov examined 449 rodents; when he dissected the four hundred and fiftieth, he at last saw the long awaited plague of the previous year.

The plague's path through the winter was deciphered.

But the plague specialists were not certain that this was the main path.

The microbes were obtained when the internal organs of the rodents were dissected. Was it possible for them to get out themselves from this peculiar form of prison, to multiply, to get into the blood in order, through the medium of blood-sucking insects, to pass to healthy rodents, and so cause an outbreak of epizootic disease?

Evidently this was by no means always possible. Scores of days of idleness weakened the microbe and strengthened the protective forces of the suslik's organism. The likelihood of a mass break-through of microbes into the blood was not very great.

The subsidiary path of plague was discovered. The main path now had to be found.

* * *

When the flea sucks the blood of a plague-infected animal and imbibes thousands, even millions, of microbe bodies, it does not die itself, but infects with plague the healthy animal or human being on which it finds itself. This was known before, but the supposition now arose that insects play a far more important part in plague "economy." Was not the flea, perhaps, the winter storehouse of the living, active, virulent microbe in the abandoned nests of the rodents which died of plague during the previous season?

Searches were made over thousands of kilometres of the uninhabited steppe. Soviet investigators hunted the enemy that was many times smaller than the plague-sick rodent, but was perhaps far more dangerous.

Searches were made that required investigating methods of high precision, the tirelessness of explorers but, most of all, self-sacrifice, courage, unrelenting persistence in achieving the goal.

One had to know whether the flea that sucked the blood of the plague-stricken rodent was capable of living through the winter and preserving the infection. Yoff proved that plague bacteria can live for more than a year, for 396 days in fact, in the belly of the flea. Laboratory experiments were taken directly to nature. Fleas in tiny cotton bags were lowered into the burrow of a rodent at a depth of about two yards. Every thirty or forty days, the nests were opened up, some of the bags were taken to the laboratory and microbe cultures were prepared from the insects that were still alive.

The microbes that entered the belly of the insect preserved their full power till the spring-time. The experiment explained a great deal, but it immediately called forth objections.

In its natural state, the flea is not surrounded by an armour of cotton material. Some scientists considered that large numbers of beetles destroy almost all the insects hidden in a burrow in the course of the winter. This black watchman inhabits every burrow. Only an insignificant quantity of bloodsucking insects break through the line of beetles, they argued, and it is difficult to believe that the plague flea could keep alive from autumn to spring.

Out in the steppe, in the ordinary conditions of living nature, the searches for plague-infected insects continued. Gaisky investigated 12,770 fleas obtained from 216 nests during the winter. Another group of scientists investigated 80,000 insects.

The bacteriologists carried out tens of thousands of the most delicate operations.

Before its "operation," the insect is washed in three tiny baths and placed in physiological solution. This completes the preparatory work. A needle penetrates the belly of the flea. The scientist cautiously transfers the tiny drop of liquid suspended on the tip of a platinum needle on to a specially sterilized glass slide. All that remains of the insect is thrown aside to be disinfected—it may be very dangerous material.

Through the eyepieces of an anti-plague mask, the research worker sees that the liquid is of an almost indistinguishable, yellow shade. Evidently there are traces of blood. There is some hope, therefore, and ten-fold attention must be given to the matter. The scientist's muscles involuntarily become tense, but the movements remain unhurried, as before.

A Pasteur pipette draws up the feebly tinted liquid and transfers it to agar-agar in a Petri dish.

The remainder of the drop is tested with benzidine. The characteristic change to blue indicates traces of blood and, what is more, blood that is not fresh.

One look at the Petri dish, before placing it in the thermostat. Culture No. 606, from nest No. 30.

And again, in the same order, the 607th, 1,000th, 10,000th operation is performed.

The time comes for a bacteriological study of the results obtained. A large quantity of plague colonies is immediately noticed on culture No. 606. With the customary movement, the hands are plunged into corrosive sublimate. In that second, not only the hands but the whole mind and body are rested. The work has taken almost twenty-four hours, but the research worker does not feel tired; it is as though the corrosive sublimate washes tiredness away, together with the infection.

Culture No. 606—the microbe colony which lived throughout the winter in the belly of a flea, which managed to break through all obstacles and through the chain of beetles—demonstrates how plague infection is preserved during the winter months.

Thus, yet another stage in the collective work is completed.

Soviet scientists Yoff and Tiflov made a close study of the fleas which live as parasites on steppe rodents, and they have explained the importance of certain species of fleas in the spread of plague.

Tumansky and Polyak were the first to prove that it was possible for plague microbes to be preserved for a long time in the organism of fleas, during the period separating one outbreak of epizootic disease from another. They succeeded in finding plague fleas in the uninhabited nest of a suslik, five months after the end of an outbreak.

Stupnitsky, Tinker and many others completed the chain of investigations. It appeared that the microbes fully preserve their strength; they, together with the blood of the plague-stricken suslik, could only have entered the belly of the insect when the summer epizootic disease was at its height and long before the rodents' winter hibernation.

All the paths and by-ways that plague has in nature were studied down to the last link. Then the general offensive began. In America, the plague microbe conquered new expanses; in Asia (chiefly in British India) it killed 1,026,779 people in only four years between 1924 and 1928. But in the U.S.S.R., plague no longer exists.

Disease has disappeared in the U.S.S.R., and its history might have been considered at an end, if the microbe only existed in nature, and had no allies on the other side of the frontier.

It has been possible to destroy plague, but science has had to find means of preventing the diseases and curing it, means of fighting against those people who are trying to resurrect plague and use it for their own purposes.

"A M P"

Southern fruit-bearing plants, modified by botanists, have been transferred to the different climatic zones of the Michurin orchards of the North. In the Salsk steppes, millions of the trees which collective farmers planted were scorched by dry winds and perished. But a second, a tenth, a hundredth row of trees grew up after those first gnarled, yellowed, semi-scorched ones. And now the hot dry wind itself has lost its way among the forest paths and the trunks of oaks and maples. In the North, vegetables and grain crops have broken through the line of the Arctic circle. In Siberia, people have "trained" fruit trees to grow close to the ground, where they are protected in winter-time by a blanket of snow, and by the warmth of the earth during early morning frosts.

This progress involves all branches of science, from physics to botany, from technology to microbiology.

Many years ago, one little girl among thousands of others died of plague in Tananarive, Madagascar. The initials of her name were "EV" and were used to signify the strain, the culture of bacteria, obtained from this victim of the plague microbe.

Year after year countless generations of the "EV" strain, which had nothing remarkable about it, followed one after another, side by side with the "Glasgow," "Bombay" and other cultures.

This went on until something unexpected occurred. A scientist infected a group of guinea pigs with "EV" microbes. Several days passed, but the animals remained well. The "EV" strain, which originally killed and had many times shown its power in laboratories, had no effect on this occasion. The guinea pigs should long ago have died, yet there they were, running round the cages and sniffing at their troughs in anticipation of food.

Perhaps, for some unknown reason, this particular group of laboratory animals possessed some natural immunity against plague?

The experiment was repeated with other animals under conditions which fully ensured that they should become infected. The result was the same: the "EV" strain had ceased to kill.

It is easier to imagine prussic acid turning into sugar than to imagine plague that is harmless. But there it was. The "EV" strain had made the round of all the large laboratories of the world. It was undoubtedly a plague microbe, having all the properties that made it similar to ordinary bacteria (the nature of its growth, the shape, the reaction to bacterial stains); but it was non-poisonous, it was avirulent, as microbiologists describe it.

Many times Magdalina Petrovna Pokrovskaya's thoughts turned to this experiment, performed by nature, without the help of scientists. The experiment aroused great hopes and raised a crowd of acute questions.

To some scientists, the world of microbes seemed to be invariable, permanent, as though cast in metal. But it now transpired that the microbe world is subject to variation like all other living things.

"What if I were to take this power in hand?" thought Pokrovskaya.

Many decades have passed since the time when people noticed the existence of variability in plants—the sudden appearance of new properties, which the preceding generations had not possessed. But only in our day have biologists learned to produce these variations and direct them.

This time a long and difficult road had to be travelled, not in terms of decades, but of years and months. The "EV" strain had lost its virulence suddenly, for reasons which up to then had not been studied. Probably, it was possible to learn how to take the sting out of plague deliberately, to create new, harmless varieties of microbes at will. And this would have tremendous consequences for mankind.

The Khavkin vaccine could reduce the death rate fourfold, but it still could not save twelve million human lives from death in India. It protected forty or perhaps fifty million, but was unable to save twelve million. Science could not reconcile itself to such a loss of life!

Khavkin had prepared his vaccine from dead plague microbes. Live vaccines would have tremendous advantages. These non-poisonous or almost non-poisonous varieties, born of virulent bacteria and almost the same, in all their properties, as their ancestors, would "teach" the organism how to deal with real plague. Protective forces would come into play before even the plague microbes made their appearance in the blood. Plague would encounter ready-prepared defences and, in the struggle for life, the human being would be given additional days. By selecting various live vaccines, scientists would finally discover the particular variety, or combination of varieties, which would ensure complete, one hundred per cent immunity.

The wolf and the dog came from a common ancestor, but the dog watchfully guards the flock against the kindred beast.

Once cow-pox was injected into man for the first time, and it was found that after "pulling through the illness," after overcoming the live vaccine, the organism became protected by a most reliable armour, against natural smallpox.

The day will come when injections against plague will become just as simple and effective. Magdalina Petrovna Pokrovskaya dreamed of one thing only: of bringing this day nearer.

But how could the microbe world be changed? What means could the scientist use in order to determine the direction in which the microbes should change, and to select the variety he needed?

These were times when geographers, physicists and airmen were discovering the secrets of the Pole: when astronomists were using methods of spectral analysis and bringing other worlds so near that it was as though man were making a journey through the fields and mountains of Mars, establishing what plants grow there, the colour of their leaves and their shape; when the creation of the electronic microscope made it possible to see even filterable viruses.

Everywhere man was becoming the powerful master.

By special means molten quartz was made into needles, scalpels and hooks. With the aid of invisible instruments and complicated transmission belts for slowing down a thousand-fold the movement of the hands, man has learned to "operate" on the microscopically minute living cell.

But here the very latest micro-surgery could not be of assistance. To take the sting out of plague meant reconstructing the whole substance of the microbe by unknown biological methods which were both coarse and delicate, and, moreover, to do so without killing the microbe.

It was a difficult task, but Pokrovskaya felt she had found the right road.

For a very long time bacteria were regarded as the first step on the ladder of living nature. But a few decades ago, something new was revealed to the observant scientists.

Sometimes a healthy, virile colony of bacteria begins to perish. Dark and light spots appear on the surface of the colony and then rapidly spread on all sides. Some power "melts" the culture of bacteria.

In those days, before the discovery of the electronic microscope, the cause of the changes was invisible. Even with a magnification of two thousand diameters, the research worker could only distinguish the results of the action of the unexpected ally: the dead bodies of bacteria; isolated mutilated islets of the once healthy and powerful colony, which had survived the battle.

Without as yet knowing what they were—dead substances or living organisms, which so rapidly and mercilessly mete out punishment in the bacterial world—scientists called the invisible ally a bacteriophage, or devourer of bacteria.

If a suspension of the colony, after it had "pulled through the illness," is put through the finest filter, the filter will retain visible particles and the filtered liquid will appear to have nothing in it, when looked at under an ordinary microscope.

But it only appears to be empty. It is easy to prove that the filtrate is full of a strong and terrible population. Take up a drop of the liquid in a platinum loop and drop it on a healthy colony of bacteria. After some time has elapsed, the same battle will take place. The colony will become light, the majority of the bacteria in it will die, and those that remain will be weakened and mutilated.

Perhaps the bacteriophage was indeed the power that could be used to change the microbe world, the power for which Pokrovskaya had been searching in recent years? Would it not be possible to produce an avirulent "tame" plague from the microbes which had become weakened and modified after the battle with the bacteriophages?

Experiments were begun which lasted five years. Thousands of plague colonies perished completely without producing the desired result. All that was left on the field of battle were dead microbes and dying cripples. Efforts to obtain colonies of living plague microbes, having no sting and capable of developing normally, were unsuccessful.

Pokrovskaya had not hoped for early success. The experiments were repeated again and again. It was probably the first time, in the history of Soviet and world science, that a scientist had ever tried, not simply to destroy the hostile world of bacteria, but to learn how to change it, as man has changed breeds of cattle and species of cultivated plants.

Thousands, tens of thousands of times the scientist put bacteriophages and plague microbes into conflict and watched progress on the "field of battle." Finally the goal was reached. In the cultures subjected to the influence of bacteriophages, Pokrovskaya discovered peculiar dense colonies, permeated with a viscous substance. She transferred the inhabitants of this unusual plague colony to fresh agar-agar. When the flasks containing the microbe cultures were taken from the thermostat, well-developed colonies were visible on the surface of the nutritive medium. "Transparent as dewdrops," wrote Pokrovskaya, in her record of the experiment. The new variety of microbes, produced deliberately and according to plan for the first time by a research worker, were nursed and reproduced, just as Michurin nursed and reproduced his new species of plants. The new variety was called "AMP," subsequently hundreds of "AMP" colonies were grown in Pokrovskaya's laboratory.

Then the time came for "AMP"—the man-made species of plague microbe—to demonstrate its properties not

Magdalina Petrovna Pokrovskaya

on nutritive media, but in the blood of laboratory animals.

Most important experiments began. During the days that followed, the research scientist tested her power over nature.

Two hundred and eleven laboratory animals were infected with "AMP" microbes: 159 susliks, 31 guinea pigs and 21 white rats. Under the microscope it was possible to observe how the lymphocytes (which usually only seize upon, but do not destroy, the real, virulent plague microbes) began a united offensive, when they encountered "AMP," and emerged victorious from the brief encounter.

Of the two hundred and eleven animals, only one little suslik weighing not more than two ounces, died during the experiment.

Pokrovskaya boldly increased the dose. A whole army, 72,000 million living microbes were injected into the blood of a guinea pig. Even these vast forces were unable to break through to vitally important organs, but perished in the blood of the experimental animal.

And yet, the "AMP" microbe was undoubtedly a variety of the plague organism, was derived from it. In almost all its chemical and biological properties, it was similar to the real deadly plague. And it was to be expected that after coping with "AMP," the organism would "learn" to triumph over virulent plague microbes as well.

The experiments became more complicated. Virulent microbes, in doses known to be lethal, were injected into 41 susliks that had successfully coped with "AMP." Four of the susliks died; thirty-seven, or 90 per cent, remained alive. Of the 26 control susliks, that had not been vaccinated, 80 per cent died and 20 per cent survived.

The "AMP" microbes created immunity.

There remained the last test. In science it is known that a microbe which does not harm a hen, for example, may easily kill a man. The "AMP" culture, which does no harm, or is almost harmless, to the guinea pig or rabbit, might behave quite differently in the blood of a human being.

This was a new variety, that had never existed before, and its properties were being studied for the first time.

One had to reckon with the possibility that the new culture would be harmful to man, but far more likely was the supposition that the "AMP" culture would create a more stable immunity than could be reached by means of Khavkin's dead vaccine. It was so important to confirm this supposition that Pokrovskaya felt she had no right to procrastinate.

"The experiments must be repeated on monkeys," was the decision in Moscow. "We must follow the evolutionary ladder from the lowest species to the highest and gradually prepare for the decisive experiment on man."

Pokrovskaya could not agree to the postponement. She felt as Zabolotny had felt: "There is no time to waste!"

Later we learned that during those pre-war years microbiology in fascist Germany and Japan was proceeding along a totally different road. There, they were trying to produce super-toxic varieties from the toxic varieties of plague and were building special institutes for the purpose. The forces of Russian science had revealed plague in its most important fortresses and mercilessly expelled it from all its storehouses. Yet, there, they were working to produce a bacteriological weapon. The fascists had come to the aid of the retreating bacteria.

There, they were preparing to test the power of microbes on people confined in concentration camps. And at staff conferences, they were making business-like comparisons between the lethal properties of plague and those of other means of destruction, comparing the cheapness and convenience of chemical and bacteriological warfare with that of war by means of conventional types of arms.

Pokrovskaya realized that the state did not wish to risk the life of a scientist, but she felt that the danger that threatened her country gave her the right to take the risk. She felt that it was now very necessary to make an experiment on a human being, and that there was only one life a scientist had the right to risk in these circumstances, and that was his own life.

She decided to inject herself with "AMP" culture. The experiment began on March 8. Pokrovskaya had a headache; for several days she had had influenza. "So much the better," she thought. "I shall know how 'AMP' works in the presence of the influenza virus."

Pokrovskaya filled a syringe with liquid containing 500 million microbes and made a subcutaneous injection. By midnight a large, bright red spot had appeared where the injection had been made.

"Curious," thought Pokrovskaya. "This time the human organism immediately 'noticed' the invasion of a foreign substance, and produced this strongly inflammatory reaction, in an effort to restrict the spread of disease."

The next day the temperature had risen to 101.4°. The battle to destroy 500 million "AMP" microbes continued.

By evening the temperature had fallen. On March 17, Pokrovskaya made a second injection. This time, too. everything turned out satisfactorily.

When Pokrovskaya told of her experiment in Moscow, she ended her report with the following sincere and ardent words:

"I want you to understand that I did not, for a second, consider myself a suicide case. Honestly, there is nothing of the suicide about me. I love life with all my heart and I made the experiment because I believed, and believe, in the "AMP" culture. I believed, and believe, that the workers at our institute have created a new means of struggle against plague, one that is more perfect and effective than those we have hitherto had at our disposal."

Other plague specialists spoke when Pokrovskaya had finished.

As she listened to her colleagues, she was more deeply conscious than ever before of the broad front on which Soviet science was advancing.

She thought about the interesting paths that lay before microbiology. Bacteriophages would help to produce more than "tame" plague. Why not try, by this or some other means, to produce avirulent forms of the typhus or dysentery bacteria? Why not change the whole extensive realm of disease-producing microbes?

THE "EV" STRAIN

"Submissive microbes" was the heading Daniel Zabolotny gave to one of the last articles he wrote. Microbes altered by Soviet science and made submissive.

Avirulent live vaccines were the keys which helped to wind the spring of the organism's defence forces.

More than one spring had to be wound and more than one key, perhaps scores of keys, were required. The "AMP" microbes protected ninety out of a hundred laboratory animals from plague. But in ten cases out of a hundred, plague was stronger than the forces opposing it. This, therefore, was not yet final victory. The correct road had been selected, but the scientist was not yet in possession of impenetrable armour.

It was not one variety of plague microbe that had to be conquered, but all the varieties existing on earth. There exist oceanic strains and those born on the continent; they possess certain properties which make them different from each other. As Deminsky foretold, the environment must have left, and did leave, its imprint on bacteria. Microbes can be more or less noxious.

Soviet science wanted to create a vaccine which would prepare the human organism in advance for its encounter with any variety of plague microbes.

Experiments continued in several laboratories. After the "AMP" strain had been produced and tested, the turn came for the "EV" avirulent strain, already mentioned, to be studied.

The Micro-Biological Institute was housed in a two-storeyed building, which in no way resembled the gloomy stone Plague Fort in the distant past of Russian science. On one side, the trees spread their branches across the wall and over the street; on the other, their branches reached as far as the windows of the laboratory.

The thought struck me that even this peaceful aspect of the institute was a sign of the new confidence and the strength of Soviet science in the struggle against disease.

We were introduced to the people who had taken part in a recent experiment: Tumansky, a plague specialist, taciturn and calm; Korobkova, an elderly woman scientist with a kindly, tired-looking face; Berlin, a man with stern, attentive eyes, wearing a tunic-style jacket with a Mongolian decoration on the left side of the chest.

After a few preliminary questions, Berlin said:

"You ask whether we thought about the dangerous side of the experiment? First of all, we were confident of its successful outcome. Then, I rather imagine that an officer commanding an attacking unit rarely asks himself whether he will come out alive. He thinks of what is most important: whether the offensive will succeed. This, too, was after all an important and necessary military operation. The surgeon who works close to the front hears everything: the rapid breathing of the wounded, the replies of the sister, the sound of blood in a cut artery, everything except the roar of battle. Fortunately for the human being work and the feelings it evokes are stronger than everything else. The thing that chiefly concerns the research worker is the danger that threatens the experiment, but when that danger disappears..."

"Well, now fire your questions," said Tumansky.

In April 1939 permission for the experiment to be carried out was at last sent from Moscow. It was decided that first of all three research workers—Korobkova, Berlin and Tumansky—would be given injections of the "EV" culture: in recent years it was they, more than anyone else, who had studied this strain.

Dr. Yashuk injected each of the three doctors with 250 million "EV" microbes.

The scientists were isolated from the world. They lived in the low building of the isolation ward. The ward could be entered only after a mask and special clothing had been put on. If the "EV" microbes were to revert to their past, plague must not escape from the isolation ward.

Hundreds of people were thinking of the fate of those undergoing experiment. But in the isolation ward all was quiet. Korobkova was correcting the proofs of an article for the *Vestnik Mikrobiologii* (Bulletin of Microbiology); Tumansky was busy writing; Berlin was wholly engrossed in his research into methods used by Tibetan medical men to combat plague. In 1930 he had been sent to Mongolia and parallel with his practical work there, he had started some research. At first he could not make much headway, yet each day he felt an increasing urge to complete the work. Lamas travelled all over the country armed with their incantations and medicines with strange names, like the "broth of seven treasures." They were an obstacle to real science and hampered the difficult work of the doctors. This was no archive investigation, but a struggle against the obsolete, which still held sway over hundreds of thousands of human minds. It was the same great struggle for human lives.

The lamas were unwilling to reveal their methods of treatment. They hurriedly set off as soon as a Soviet doctor appeared or they silently sat in a dark corner of the *yurta*, refusing to answer questions. Berlin had almost despaired of finding an authentic review of the state of affairs in Tibetan medicine when, while on one of his travels, he made the acquaintance of an old philosopher. He was well versed in philosophy which made him a *gabju*, and knew a great deal about medicines and was therefore a *manramba*. This *gabju-manramba* listened to what Berlin had to say and then, surprisingly, agreed to help him. Why? Perhaps he believed in the powers of his own ancient science which had not changed for centuries, or perhaps he loved his people so much that he was ready, for their sake, to risk everything that he, his father, his grandfather, and his great-grandfather had served.

The old scientist drew up a "summary of information about plague" and presented it to Berlin, who read the manuscript in a state of great excitement. It was like a journey down the ages. It mentioned the philosophical work "Bodhichryävatara," written in India 1,200 years previously and also numerous other works by philosophers and medical men. But in the *gabju-manramba's* summary, popular experience and the faithful observations of past doctors were buried under age-old layers of mysticism and so made useless. The manuscript was a collection of thoughts that had once lived, but now these thoughts, stifled by the lamas, had ceased to develop; now, like everything dead, they were a hindrance to the people.

The working day passed according to a strictly planned order. At definite hours, the institute doctor paid his visit. He took the temperatures and watched the state of health of Korobkova, Tumansky and Berlin. It was at such times that one definitely felt that this was no ordinary working day, this was not simply a room where people studied, but an isolation ward.

After supper, the light in the isolation ward was put out and all was quiet. The disturbing hours began the following morning. Tumansky's arm pained him badly and his temperature was rising rapidly. Dr. Mitin himself removed the thermometer from the patient.

"Everything is in order, Victor Mikhailovich," said Mitin to Tumansky. "98.8°."

Actually the temperature was 100.4°. Tumansky himself felt the fever growing on him. But he was still quite sure that "EV" had not changed its properties and that most likely the injection had brought on an attack of the rabbit-fever he had caught some time earlier, during one of his expeditions.

Meanwhile Berlin sat at the table and continued to study the lama's manuscript. How many times had he been forced to put aside this work in order to set out for some epidemic or to perform other urgent work! And yet the work was progressing. The terminology of the lama medicine had been deciphered. A "big yellow medicine" and other soporifics recommended by the summary were composed of *gi-wang* (ochre made of iron oxide and clay), *monkshood* (the roots of *Aconitum napellus*), *mu si* (sulphur) and *li shi* (cloves). Soviet bacteriologists tested the effect of these medicines on laboratory animals that had been infected with plague. The soporifics did not help. The impotence of lama medical science was clearly demonstrated in the laboratory.

Dr. Obukhova entered. One could not fail to notice, even by the tone of her voice, that she regarded the situation as very serious. Tumansky reassured her.

"I can tell you honestly I'm feeling better and there's truly no cause at all for alarm. It's only a pity if all this somewhat confuses the results of the experiment."

And indeed a few hours later the temperature curve dropped at first slowly, but later quite definitely.

"Tibetan medical theory," wrote Berlin, "instils into the population false, ready-to-hand views and canonized dogmas, thereby diverting empiric searchings from the correct path and, because of this, acting as a factor which hampers the development of science and practice."

Berlin came to the end of the manuscript and put it aside. For several hours, Tumansky's temperature had been back to normal and he had been feeling well. He was quietly reading a book. Korobkova impatiently watched the clock: she was longing for her microscope, her home and the laboratory, and these last minutes of the experiment seemed interminably long.

When the quarantine ended, the institute staff gave a warm welcome to the doctors who had undergone the "EV" culture experiment. Everyone wanted to shake them by the hand, to say a pleasant word or to pay them some little attention.

The institute decided to continue experimenting. Another five people, laboratory workers and assistants, were vaccinated with "EV"; they had for a long time been requesting the right to take part in the experiment. There were as many as eight volunteers in the third group.

So ended the experiments in a Soviet scientific research institute.

In December 1939, before publishing the account of this experiment, I decided to show the manuscript to one of the people experimented on.

It was a snowy winter's day, but warmer than usual for the time of year, and I remembered it for a long time afterwards. Berlin read the account, made a few remarks and then, as he had promised when we first met, began to tell me about his life, about the fight against typhus during the Civil War and his work in the plague epidemics in Mongolia. Quite imperceptibly, as though his life was a component part of another, larger biography, he went on to tell me about the whole history of the struggle of our country's science against plague.

Abram Lvovich Berlin

"And yet not so many years have passed," he said. "Isayev who caught the first plague *tarbagan*, Suvorov and others who took part in the Manchurian epic, are still alive. A long distance has been travelled, yet the period it has taken to realize the idea adds up, after all, to the span of only one human life." Berlin was silent for a moment, then he added: "If one wrote about this work, one might call the book: 'The story of an idea,' or better 'The realization of an idea.' "

We agreed to meet and talk in more detail on another occasion, but it was not possible to do so, as a few days later Abram Lvovich Berlin died as the result of a difficult and dangerous laboratory experiment.

AGAINST DEATH

This book was started before the war. At the front the unfinished work left at home in Moscow was frequently remembered.

It was remembered because, during the war years, it became particularly clear that the experiments made by Pokrovskaya, Berlin and other Soviet plague scientists were part of the battles against fascism, and the victories won in the laboratories were war victories.

This is indeed so. In the days of battle in the Kursk salient, three volunteers far back in the rear were trying out, on themselves, a new method of anti-plague injections made from live vaccines. Two of them had 1,100 million microbe bodies injected into them and the third—600 million.

The experiment was the continuation of a series of scientific researches and, simultaneously, a battle not against some possible military opponent, but against a real enemy; not only against plague microbes, but also against the people who were trying to use microbes against mankind.

Two sciences were in conflict. While increasingly reliable methods against plague were being produced in the U.S.S.R., a danger more terrible than the 1911 Manchurian epidemic was developing outside Harbin, in Japanese-occupied Manchuria.

There, where the very earth cherishes the memory of how Russian science worked to save, and did save, a tremendous country from the scourge of epidemic, in the country where Zabolotny first proved the possibility of completely eradicating plague, a plot against humanity was being hatched.

Near Pingfang station, a large area of land was enclosed behind a wall of earth and barbed wire. Armed guards of the Kwangtung Army and a high tension charge through the wires protected the approaches to this territory. Detachment No. 731 under Lieutenant-General Ichii Shiro of the Japanese Army Medical Service operated behind the barrier. The fact that General Yochijiro Umezu, Commander-in-Chief of the Kwangtung Army, General Kasahara, Army Chief of Staff, and Princes Takeda and Mikosa paid a visit to the detachment, testified to the great importance the Imperial Staff attached to the work of the detachment.

The guests closely examined the wing which housed the secret departments of detachment No. 731. Lieutenant-General Ichii Shiro, a lively little man, walked beside the honoured guests, his grey head respectfully bent.

"Our point of departure is the indisputable thesis that, since the time of Pasteur and Mechnikov, science has been proceeding along the wrong road," he said. "It is still not too late to correct the error. Instead of using disease to rid mankind of inferior people and the poor, science has tried to destroy disease. And it has done much to achieve this aim, which was incorrectly set. We can act more rationally, we can fight with the aid of armies which are infinite in number, which require no payment, which need no ammunition. . . ."

By way of completing the phrase, the Lieutenant-General made a slight gesture indicating the territory of the detachment. One- and two-storeyed buildings stood in strict barrack order over the extensive area. Green lawns stretched between the roads and the buildings. The barbed wire entanglements were camouflaged from the inside with wild vines and rose bushes.

"Does not the appearance of such armies indicate a new stage in the history of civilization?" asked Ichii Shiro.

The guests entered a long, bungalow-type building. Servants gave the visitors masks and special boots and clothing. Inside the laboratories, the staff workers in grey uniform masks rose from their places and bowed silently—efficient members of the staff, each looking very much like the next, and none of them looking at all like people.

There were thick blinds over the windows and the building was flooded with a lifeless light from mercury vapour lamps. The visitors hurried out of doors. As they walked over the yellow sanded paths, skirted by green lawns, the General resumed his explanations:

"We are working with plague, cholera, anthrax, typhoid, paratyphoid and gas gangrene microbes. The advantage of our method is that the investigations are made both on animals and on people. There is nothing new in principle about it. Many scientists have injected themselves with dangerous infections. But to work in that way is first of all irrational and, secondly, it is slow: a thousand objects are required for each experiment, not just one.

The General fell silent, evidently giving his guests time to think over his words and ask any questions they wished. But everything had been clearly outlined and no questions were forthcoming.

Pointing to a large brick building with bars over the windows, Ichii Shiro continued:

"Here we keep hundreds of experimental objects at a time. There are common cells, required for experiments on the transfer of infection from one person to another, and isolation cells. People condemned to death in Japanese and Manchurian courts and also persons whom it is considered expedient to destroy without trial, are sent to us. We always have plenty of material. Experiments are made on men and women, people of all ages, since our task is completely to destroy life in those districts where we are conducting, or intend to conduct, military operations. This arrangement of the work makes it possible to carry out the most varied operations. A special proving-ground has been equipped for the detachment at Anda station. Groups of ten or twelve prisoners are taken there. Then porcelain bacteriological bombs are dropped from planes, or bacteriological shells previously placed on the proving-ground are detonated. Thus, we study the efficacy of individual types of bacteria, methods of spreading them and their lethal power. . . .

"Actually, even with the proving-ground, it is not possible to experiment on a sufficiently large scale and in the complicated conditions one meets in the real theatre of military operations. Therefore, whenever necessary our planes fly out from the territory of the detachment. So far we have ten planes, but the number will be increased. In the summer our detachment carried out infection with plague of localities in the neighbourhood of Nimpo in Central China. Through intelligence reports it was established that the desired result had been obtained: an epidemic of plague broke out in the town.

"The planes have special devices for spraying bacteria into the air. By this method we can immediately cause an epidemic not of bubonic plague, but of pneumonic plague, the effect of which, as you know, is far stronger. Research is being made into infecting people with masses of plague-carrying fleas. The insects are bred in branches of the detachment situated in various parts of Manchuria. In one district of China, after our troops left the locality, aeroplanes were used to infect the territory with anthrax bacteria and other epidemic diseases. One can judge of the power at our disposal today by the single fact that the equipment of department No. 4 of our detachment alone can produce 30,000 million million microbes in a few days."

So said General Ichii Shiro, commander of Detachment No. 731. He was preparing to develop his detachment into armies of bacteriological warfare and to repeat the "experiments" made in the area of Nimpo and other Chinese towns on a scale which would cover whole countries. But he failed, for lack of time.

The Soviet Army advanced too rapidly. It routed the Japanese fascists together with their detachment No. 731, as it had already routed the Hitlerites, who were also preparing for bacteriological warfare.

The plague stronghold too, which was one of the most dangerous for the world, our troops captured by storm, arms in hand.

Two sciences. On the one hand the murderers; on the other the Russian and Soviet scientists, who test live vaccines on themselves, who take tremendous risks and, if necessary, die courageously and honestly as did Lebedeva, Deminsky, Berlin, who devoted their lives to their country. One front opposing the other.

That is why these victories, won in the laboratories by Soviet scientists, are so important. Soviet science and Soviet methods of creative scientific research, the live vaccines which gave such reliable aid in the struggle against bacteria, the people who produced those vaccines, all were found to be stronger than the science of the enemy.

The forces of life again proved to be stronger than death.

THE EXPERIMENTS CONTINUE

The Hitlerites reached the southern steppe town where Magdalina Petrovna Pokrovskaya was at work, and were driven away from it. The war ended. After the war, the battle between the Soviet people and nature became still more tense, never halting for a single day.

It is likely that during all her working years Pokrovskaya's thoughts never once dwelt long on the physical danger connected with her experiment. But it was difficult not to think of the other danger which threatened not the life of the research worker, but her work.

Soviet science was confidently proceeding along the road Pokrovskaya had mapped out. Zhukov-Verezhnikov and Khvorostukhina together created a new live vaccine "ZhV," which possessed a wonderful power of producing immunity; Korobkova obtained another strain of avirulent microbes. In many laboratories plague specialists tried out, tested and perfected live vaccines.

Meanwhile voices were heard which asserted that these avirulent varieties did not exist and could not exist.

"It is not within our power to change inherited properties," declared some scientists. "What you are producing in your laboratories are not new varieties but only transient modifications in the invariable and stable microbes. These modifications will vanish, if not in the first, then in the fifth, tenth, hundredth generation, and the same old breeds of microbes will grow on the agar-agar. The enemy has always been and will continue to be the enemy, just as a compressed spring will inevitably resume its former shape."

Of course, the idea was not put in quite such a blunt fashion. It was bolstered up with quotations from most reputable books, and wrapped in a web of elastic and flowery formulae. But the essence was the same.

"You have not produced new varieties of microbes, but only bacteria which have undergone temporary modifications," Pokrovskaya and her friends were told. "They are not stable properties brought to life by man, but a track like that which a cart leaves on the sand: a little time will pass and the track will disappear."

It was hot working in the laboratory. The wind tossed the yellowing leaves down the street, they clung to the fast-closed windows. The special clothing hampered movement, the rubberized material kept the air from the body. It was like being in the hot atmosphere of a steel works. But the work was all engrossing and, after a few minutes, one simply forgot the physical discomforts.

The experiments were continuing.

"Unstable modifications." Yet Pokrovskaya and many other Soviet scientists had for very many years tirelessly tested the permanency of the properties of the new plague microbe varieties.

The scientists had injected themselves with allegedly unstable, "temporary modifications" of plague microbes. And, if necessary, they were prepared to repeat these experiments. They would calmly repeat them, because they were convinced that Soviet science had selected the right road.

Avirulent varieties of microbes opposing virulent ones. The product of human labour opposing what nature had created.

More and more clearly the possibilities, which the new road of struggle against disease offered, began to take shape. One could see under the microscope how the cells of the body, which had been trained to resist avirulent cultures of the plague microbe, went into action. The leucocytes destroyed the plague microbes. And yet, before the injection, they had been powerless in the struggle against them. The cells which had previously met the enemy passively, or had entered into the struggle too late, were now taking part in the battle from the very earliest minutes.

THE THIRD TASK

Three main tasks had to be solved.

To destroy plague in nature completely, to prevent not only epidemics but also isolated cases of plague sickness.

This first task has been solved in the U.S.S.R.

To find live vaccines capable of protecting man against microbes in countries where disease still exists or to which it can be carried.

We have seen how that second task was tackled.

Finally, means of curing pneumonic plague had to be produced and the possibility of using the plague microbe in bacteriological warfare had to be wrenched from the hands of the enemy once and for all.

It had not been possible to solve the third task. In a hundred cases out of a hundred, the patient died when infected through the lungs with plague, even when timely treatment was given from the very first moment of the development of the disease.

Again, step by step Soviet science examined the whole history of the efforts to cure pneumonic plague. This is a long story, perhaps the most hopeless, thankless story in the whole of the period spent on man's conscious struggle against infectious diseases. The scientists who tried to find a means of combating pneumonic plague paid with their lives for their ideas; their graves are to be found in Russia, India, China, Austria, Germany, Portugal. So many victims, yet the goal, it seemed, was not a step nearer.

Doctors tried one means after another: serums, vaccines prepared from bacteria of varying virulence, the whole range of medicines. And all of it had to be rejected. Patients with pneumonic plague died, whether they were treated or not.

Gradually the opinion became firmly established among the vast majority of plague specialists in Western Europe and America that a cure for primary pneumonic plague was something theoretically and practically inconceivable.

But there was one feature in this sad epic of the triumph of disease and defeat of man which changed the whole picture. Even though patients did die in spite of the treatment, and the doctors were powerless to alter the outcome of the disease, did this signify that the plague microbe was indifferent to the vaccines, serums and pharmaceutical medicines and that these latter had no influence on the course of plague?

The evidence produced by all the doctors who joined in the struggle against plague epidemics gave a definite reply to this question which, subsequently, was found to be the decisive question. Although the early injection of anti-plague serum did not save the patient, it did perceptibly lengthen his life. During one epidemic the patients who were not given serum died on an average in 16.9 hours, but where treatment was given the period was prolonged three-fold, to 46.2 hours.

This meant that the doctor could already prolong the disease, force the plague microbes to retreat for a certain period of time.

Scientists now had to find out what forces came into conflict with plague inside the living organism and why it was that, in the final resort, plague invariably won the battle.

When the plague microbe enters the body of a man or rodent, it frequently does not even produce a centre of inflammation immediately. The disease microbe is camouflaged to look like the protein of the human body; this "likeness"—this dangerous and terrible mask—helps the microbe to move about without encountering resistance.

The leucocytes seize upon the invading microbes but do not digest, do not destroy all of them. Plague converts the lymphatic glands into its breeding-grounds.

The forces of resistance to the infection have not yet come into play, but meanwhile the microbe reproduces itself with tremendous rapidity. In the race between life and death, in the growth of the organism's defence forces and the growth of the lethal mass of microbes, the latter overtakes the former.

The microbes break through from the original centre to the blood. There they encounter the second defence line—the blood barrier. The phagocytic cells keep the enemy from circulating in the blood and so prevent it from spreading throughout the body. But even at this stage the resistance is most frequently not yet sufficient. The speed with which immunity is created is days and hours late. It is these days and hours that determine the outcome of the disease.

The early years of study into the behaviour of the microbe in the diseased organism already showed Nikolai Nikolayevich Zhukov-Verezhnikov and his colleagues that plague does not easily and immediately triumph, but only after winning a violent battle.

What is most important of all is that the resistance of the body increases as the disease takes its course. When the force of immunity is periodically measured from the first moment an experimental animal is infected, one is immediately struck by the important and interesting obedience to law. The immunity curve—the curve indicating the organism's resistance to disease—begins close to zero, then stretches horizontally along the co-ordinate, like an aeroplane just taking off from the air-strip, and then moves steeply upwards.

The advantages in favour of plague are "temporary," "transient," and they diminish not only daily but hourly. The microbe makes its surprise attack on the unprepared organism and this is where its chief strength lies, this is what decides the outcome of the illness.

For the first time in the entire history of the struggle against plague, Soviet scientists proved that time works for man and against the plague microbe. In the beginning of the disease the organism's defence forces are weak, but they grow rapidly.

In the beginning the task was formulated in the general words: to cure. It was now advanced in a definite and concrete form: to prolong the disease until the time when natural immunity has become strong and the organism is able to cure itself.

The moment must inevitably come: not only did the figures showing the increase in natural immunity favour this idea, but so also did observations of the life of the plague microbe in its natural conditions. In the winter, when the rodents hibernate, the temperature of the suslik's organism drops and the microbe behaves differently. In these new conditions the disease is not only prolonged, but its final outcome often changes: the animal does not die. Even when, with the advent of warmer days, the microbe finds itself in favourable conditions, it by no means succeeds in all cases in killing the rodent.

Nikolai Nikolayevich Zhukov-Verezhnikov

This means that it is theoretically possible to prolong the disease for a long time, for days and even for weeks.

It is also possible to determine the period of time that has to be gained. Generally a man dies of pneumonic plague on the first, second or third day. Daniel Zabolotny succeeded in prolonging the life of a patient to the ninth day. A case is known when death occurred eleven days after infection.

But even eleven days is not enough. The doctor has to gain another three to ten days. Then the patient will be saved.

There was now clarity concerning the direction of the road and the length of the road. In the scientists' mind there existed the plan for the cure, the plan for overcoming pneumonic plague. "Self-cure by artificially lengthening life," as Zhukov-Verezhnikov put it. People were not groping blindly in the dark, but were proceeding straight towards the clearly visible goal.

"If we had not been convinced that between the 14th and 21st day of illness immunity would develop, then the first setbacks encountered during treatment might have stopped further researches," wrote those who conquered pneumonic plague, several years after completing their splendid work.

The microbes broke over the patient in three consecutive waves. And each of these stages required a special system of defence. When the temperature dropped, it appeared that the microbe had retreated. But once the appearance of outward well-being was believed and the treatment stopped, the picture changed and the microbes broke through to vitally important centres. Account had to be taken of every minute, even of every second.

After reproducing its kind in its primary centre, the plague microbe penetrates into the blood. During this first wave of attack, this first attack by the microbes, the scientist cannot count on help from the defence forces of the organism. They are only just beginning to appear. The doctor fights the disease single-handed. He injects microbe-killing preparations into the patient's blood and watches what is taking place through the microscope. Already on the second day it is not possible to see plague microbes in the blood.

The first wave of the plague offensive has been repulsed. But the source of the disease exists, the infection is developing in the primary centre. The organism uses its fibrin to surround the centre, to isolate it and render it harmless; but what can be done in certain other diseases is doomed to failure in the case of plague. The microbes secrete masses of special fibrino-lysins. They melt the wall of fibrin that is being formed, they dissolve and destroy it. And this means that every second the microbes can again appear in the blood and general infection will result.

With a combination of medical preparations, the doctor repulses the second wave of microbes breaking through from the primary centre. As he keeps a close watch on the state of the patient, he observes certain new phenomena. By now not only are the medicines playing their part in the struggle, but for the first time forces arising in the organism itself become noticeable. The fibrinolysins come into conflict with anti-bodies. A fibrin wall is formed round the centre of pneumonic plague. Plague is locked up, the toxins produced by the plague microbes cannot freely enter the blood.

The third wave of infection is also repulsed by the medical preparations working together with the immunizing forces.

The year 1934 should go down in the history of medicine, for it was in that year that a man infected with pneumonic plague was for the first time saved from death. Since then, the system of treatment has been gradually improved.

When the Japanese militarists used the bacteriological weapon and, as a result, plague broke out after the war in a number of areas in Manchuria, Soviet doctors went out to help, taking with them medical preparations which made it possible for them to save from death a man infected with pneumonic plague.

PAGES FROM A DIARY

Nina Kuzminichna Zavyalova was a young doctor who went out with other plague specialists to work in districts outside the U.S.S.R., where there were outbreaks of plague.

The motor road climbed steeply into the mountains, slipped over the snow-covered pass and crossed the plateau. Then it began to ascend again, while the mountains drew nearer, rugged and monotonous like the grey, castellated walls of an ancient ruined fortress. The grass along the roadside looked bleached and colourless, perhaps because the sun was setting or because the air was so rare at that height.

The car drew up outside a group of buildings cordoned off by a high fence. This was the medical centre.

Zavyalova unpacked her books, laboratory equipment and medicines and spent a long time looking at the map of the district. It included some 400 miles of mountains, steppe, rivers; it took in hundreds of villages and nomad settlements; it was like an entire country, where she was responsible for the life of every person and for every outbreak of disease among the rodents.

The study of the district began. On one occasion, returning from one of her regular rounds, Zavyalova found a telegram informing her that someone had plague in the neighbouring medical district. She collected together all that was necessary and set off. With Elena Konstantinovna Demidova, the doctor in charge of that medical district, Zavyalova went to the place where the patient lay. In the semi-darkness they could hear the heavy, irregular breathing of the woman tossing on the bed. She had a feverish light in her eyes and seemed to be trying to read in the doctors' eyes whether there was any hope.

They took it in turn to sit by the patient, never leaving her for a moment. The heart that was fighting the plague toxin had to be given support. The counter-attack of the medicine slowed down the microbes' offensive.

After her turn of duty, Zavyalova toured the steppe and the villages, looking for signs of epizootic disease. The first thing she did on her return was to go into the laboratory. The guinea pigs infected with the plague microbe obtained from the patient's sputum had died. The microbe was highly virulent, then. Yet the patient was still alive. This fact made the doctors realize that the greatest danger had passed. The temperature was falling, the eyes were brightening. At last the patient was well again, and the news that a patient with pneumonic plague had been saved by Soviet doctors spread rapidly through the country.

* *

Zavyalova had developed a sensation of strength, of power over the disease, the most wonderful feeling a doctor can experience. Later, when she was accidentally infected in the course of her work, and had pneumonic plague herself, this confidence that man is stronger than plague remained with her.

At the district hospital there were three patients, including herself, with pneumonic plague, and this meant that until help arrived Zavyalova was responsible for three lives; there were no other doctors and she alone was capable of conducting the treatment.

She obtained three case history forms and filled them up in great detail, trying not to overlook the smallest trifle, but to write down all the essentials of the treatment so that, should she herself lose consciousness, treatment would continue to be given to herself and the two other patients. It was very difficult to keep on working. Her heart was feeble and from time to time she seemed to be falling into cold, grey space; but when consciousness returned, she continued to use every second of time to plan the method of treatment.

Help was late in coming. There had been a continuous downpour of rain in the town, some 600 miles away, and the aeroplane could not take off because the aerodrome was flooded.

There was not a single Russian close at hand. Zavyalova felt such an urgent, aching need to tell someone about her state, to consult someone, that she began to write a diary.

Here are some of the notes from her diary.

"August 30

"I am in isolation at home.

"Treatment is strictly in accordance with N. N. Zhukov-Verezhnikov's scheme. I am trying to be calm about what has happened. I know how important it is, in combating disease, to keep the mental faculties active as far as possible. It's bad that supplies of medicine are coming to an end, and it's not flying weather."

"August 31

"At twelve o'clock I had palpitations and an hour later the temperature had risen to 99.3°

"I have forbidden my laboratory assistant to come to me without wearing the full anti-plague uniform.

Nina Kuzminichna Zavyalova

"When he first came in wearing the uniform, he was embarrassed and tried to hide his confusion by fiddling with the goggles and gloves and coughing nervously.

" 'Never mind, it's very necessary,' I said to him.

"But he went on fussing, because he was afraid the sight of the uniform would have a serious effect on me.

"How many times have we gone together in these absurd costumes to visit the sick, to make autopsies on people who had died of plague, and now here he was coming to me.

"But we had known many happy hours, had experienced the joy of seeing our patients recover.

"I have the greatest faith in the Zhukov-Verezhnikov method of treatment and this gives me strength to fight against the disease.

"And then, can I possibly let myself go even the slightest little bit, and abandon the struggle? After all, I'm something more than a patient; even now I'm first and foremost a doctor. There are patients in the ward who must be saved.

"I felt well all day. Towards evening I felt worse. Temperature 100.4°.

"The disease is developing rapidly. Undoubtedly the fact that I've been on duty every night with the patients has not been without its effect.

"I am most afraid for patient R. He is still in a very critical condition. We did not leave his side for fifteen days and we brought him through. Now he ought to get well. If only Elena Demidova would come quickly; I am sure she would cure him.

"And me, too.

"Here I lie and all the time my thoughts won't let me sleep. Perhaps it is because I am now quite close to death.

"I loved my work more than anything else. Everyone was surprised at the idea of being able to live so long in a desert, where there is no tree or flower, nor a single Russian, within a distance of three to five hundred miles.

"Yet I was never bored or lonely. It is very interesting, working in the laboratory, and when we were in the hospital we entirely forgot everything else. Sometimes we didn't go to bed for days on end; usually we slept in snatches of one to two hours, sometimes in the day-time, sometimes at night.

"We forgot about food. A nurse followed us round with plates of food and we would say: 'Later, there's no time now.' Sometimes we would nibble at food mechanically from a plate close at hand, and say to the nurse: 'We'll have something later;' then we'd suddenly realize the plate was empty.

"Our work and the condition of our patients fully engrossed us.

"When, during the war, I graduated from the Moscow Medical Institute, I didn't want to be a plague specialist. And now it seems I shall never exchange this work for any other. Even now I am sure that it is the finest work in the world.

"In plague work we actually 'drag' the patient through, drag him through with our own hands and the powers of our marvellous medicines. Death stands at our elbow, but we don't allow it to touch the patient. During the illness, we feel a hundred times that the patient is almost lost, and a hundred times we extricate ourselves from the deadlock, dragging the patient with us. There he lies, breathing heavily after the effort, and we rest with him, we relax and try not to think of anything at all, yet we notice the change in the colour of the skin and the gradual disappearance of the alarming bluish tint. And we know with every fibre of our being: this is another victory, we've pulled it off again. But an hour later we realize that the toxins are trying to get to the heart or the brain, and we strain every effort, we use all our will power in order not to miss an opportunity but to conquer death once more.

"And we know that we will certainly conquer death, no matter what happens. We know it all the time, and that is what gives most happiness.

"I know this even now."

"September 1

"I want to live!

"I want terribly to live!

"My condition has deteriorated very much.

"Short of wind, palpitation.

"But all the same I will keep calm.

"I am watching closely to make sure that the proper treatment is given to the other patients and myself. I try to read when I am not having treatment. I have with me *How the Steel was Tempered*, by Nikolai Ostrovsky and his *Letters*, my two favourite books. How good it is to have them here! There was a time when the first entry in my diary consisted of words that are very important to me:

" 'Man's dearest possession is life. It is given only once and it should be lived so that one should have no painful regrets for the years spent aimlessly.'

"How much I want to live!

"The more acute my condition becomes, the more I want to live.

"I have a strange feeling. It seems to me that the outcome of the illness depends on my resistance to death. It seems that it is not the process of infection that decides the question of life, but my own mental resistance. It is as though I shall not die because I do not want to die."

"September 2

"The longing for life is so great that I hardly feel the pain from all the endless injections. Pain and life—

it is not possible to compare them! Life seems to me to be something tremendous and dazzlingly wonderful, and life includes everything on earth.

"I am in a critical state.

"I want to sleep and sleep. The laboratory assistant still gives all the treatment I have prescribed and each time the treatment drives away sleep.

"A knock at the window woke me this morning. The laboratory assistant said a plane had flown in. Shortly afterwards I learned that Elena Demidova had arrived."

"September 3

"I am sure of one thing: we shall all survive—I and my patients. Elena Demidova has arrived, we have medicines and we shall not die.

"Elena said that she had established contact with Moscow by telegraph and that Zhukov-Verezhnikov himself was guiding the treatment.

"But even without that I knew we would not die.

"Consciousness is not lost suddenly. At first all objects retreat and take the form of silhouettes. That means the heart is working badly, there is lack of blood and the brain is failing.

"Gradually everything comes clear. It is the sort of feeling one has at dawn, very early in the morning, when everything becomes clearer and lighter. And everything will be lighter still.

"It is such a joy to see clearly, not to see dark silhouettes, but everything that surrounds one.

"And now the heart is bad again. Elena is drawing camphor into her syringe, and I say to her:

" 'Hurry up with it!'

"I count. I imagine that so long as I count and watch the working of the heart, nothing terrible can happen.

"One beat, one miss, another miss on the seventh beat, on the third, then another miss.

" 'The heart has stopped,' I say, but I do not know whether Elena hears.

"I distinctly hear Elena's reply:

" 'No pulse.'

"Everything else floats about, but one corner of the brain, the medical mind, remains clear and I think: a hot water bottle and massage are needed. Then I hear what Elena says:

" 'Hot water bottle and massage.'

"She had not heard me, but we are thinking on the same lines. It is very good to feel that even now, I still remain a doctor. It is the same as saying: I am not dying, I am living.

"There is an improvement, but I know it will not be for long, just for a moment. I hurry to say something in order to get it all said.

" You know, Elena, we've done everything possible. Nothing more can be done, the heart just isn't coping and you can't put in a new one. Tell Zhukov-Verezhnikov that his method of treatment is correct, we simply hadn't got all the medicines. And write down two addresses. . . .'

"I'll write them down later.'

" 'No, now, later it will be too late.'

"I see Elena standing and weeping, and the thought crosses my mind: she's just worn out. She even sleeps in her anti-plague costume. She takes her turn of duty nursing me, then makes the round of the district.

" 'Don't worry, and try to get some rest,' I say to Elena. 'I'm feeling much better now.' "

* * *

"When I recovered," Zavyalova related, "I was carried out on a stretcher, just before dawn, and put into a car to be taken to the town. And suddenly I noticed wonderfully bright, pale-blue stars twinkling and swaying just above my head, as though they would drop on me.

" 'Elena, look! Stars!' I said to Elena Konstantinovna.

" 'You know, Nina,' she answered. 'There's snow in the mountains already, it's very beautiful!'

"As I travelled, I slept and awoke alternately and I had the sensation that I was living for the second time. I felt that in this second life everything was definitely brighter and better than in the first. I recall seeing an infinitely broad river, all blue and gold and so quiet that it seemed to be stationary. Everything rocked gently, and my whole body was resting after its hard life-and-death struggle. As I dozed I began to think again about the future, about the work that lay ahead, about how this accidental infection should not be lost to science, just as the accidental infection that cost Deminsky his life had not been without its use to science."

In the town Zavyalova was put into a bed. She asked the doctor to take 400 c.c. of her blood and test the immunizing properties of blood taken from a person who had survived pneumonic plague.

"You understand how very important and extremely interesting it is," urged Zavyalova.

The doctor listened to her and then said:

"Please don't argue. You haven't a single superfluous gram of blood, let alone 400 c.c."

But Zavyalova did not relinquish her plan, she only postponed its fulfilment. Some time later she succeeded in having not 400 c.c., it is true, but 200 c.c. of blood taken from her. The experiments produced very interesting results and Zavyalova decided to finish the work, to test on herself whether a person who has had pneumonic plague can become infected a second time.

When she was quite well and back at the medical centre, Zavyalova no longer took precautionary measures and went without mask or goggles into the building where there were guinea pigs infected with pneumonic plague. For several days the plague microbes unsuccessfully stormed the doctor's respiratory channels. Then at last Zavyalova felt the familiar symptoms. It was pneumonic plague for the second time. But the organism was prepared for its encounter with the old enemy, the disease developed only slightly and yielded much more quickly to treatment.

Nina Kuzminichna Zavyalova is sitting opposite me, as I write, telling me of the past.

"You know," she said, "the days when I was recuperating coincided with the Khabarovsk trial. I know very well what plague is. It was physically repugnant to listen to the testimony of those murderers, but I forced myself to listen, and I thought: 'You relied on plague and some of you are still relying on it. It's no good! That weapon has been knocked out of your hands once and for all time. We are stronger than death, which means we are infinitely stronger than you.' "

Life will triumph!

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